PRIORITY DEVELOPMENT PROJECT (PDP)
STORM WATER QUALITY MANAGEMENT PLAN (SWQMP)
FOR

Imperial Beach Resort

ENGINEER OF WORK:

Richard S Tomlinson, Jr. PE
Provide Wet Signature and Stamp Above Line

PREPARED FOR:
Imperial Beach Resort, LLC
10450 South Eastern Ave., Suite 100
Henderson, NV 89052

PREPARED BY:

Michael Baker
INTERNATIONAL

Michael Baker International
9755 Clairemont Mesa Blvd.
San Diego, CA 92124
858-614-5000

DATE:
February 15, 2017

Approved by: City of Imperial Beach Date

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ACRONYMS

APN	Assessor's Parcel Number
ASBS	Area of Special Biological Significance
BMP	Best Management Practice
CEQA	California Environmental Quality Act
CGP	Construction General Permit
DCV	Design Capture Volume
DMA	Drainage Management Areas
ESA	Environmentally Sensitive Area
GLU	Geomorphic Landscape Unit
GW	Ground Water
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
HU	Harvest and Use
INF	Infiltration
LID	Low Impact Development
LUP	Linear Underground/Overhead Projects
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
POC	Pollutant of Concern
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWPPP	Stormwater Pollutant Protection Plan
SWQMP	Storm Water Quality Management Plan
TMDL	Total Maximum Daily Load
WMAA	Watershed Management Area Analysis
WPCP	Water Pollution Control Program
WQIP	Water Quality Improvement Plan

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CERTIFICATION PAGE

Project Name: Imperial Beach Resort
Permit Application Number:

I hereby declare that I am the Engineer in Responsible Charge of design of storm water BMPs for this project, and that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the requirements of the Storm Water Standards, which is based on the requirements of SDRWQCB Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (MS4 Permit).

I have read and understand that the City Engineer has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the Storm Water Standards. I certify that this PDP SWQMP has been completed to the best of my ability and accurately reflects the project being proposed and the applicable source control and site design BMPs proposed to minimize the potentially negative impacts of this project's land development activities on water quality. I understand and acknowledge that the plan check review of this PDP SWQMP by the City Engineer is confined to a review and does not relieve me, as the Engineer in Responsible Charge of design of storm water BMPs for this project, of my responsibilities for project design.

Engineer of Work's Signature, PE Number & Expiration Date

Print Name

Michael Baker International
Company

February 15, 2017
Date

Engineer's Stamp

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Project Name: Imperial Beach Resort

SUBMITTAL RECORD

Use this Table to keep a record of submittals of this PDP SWQMP. Each time the PDP SWQMP is re-submitted, provide the date and status of the project. In last column indicate changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments.

Submittal Number	Date	Project Status	Changes
1	2/15/17	☒ Preliminary Design/Planning/CEQA ☐ Final Design	Initial Submittal
2		☐ Preliminary Design/Planning/CEQA ☐ Final Design	
3		☐ Preliminary Design/Planning/CEQA ☐ Final Design	
4		☐ Preliminary Design/Planning/CEQA ☐ Final Design	

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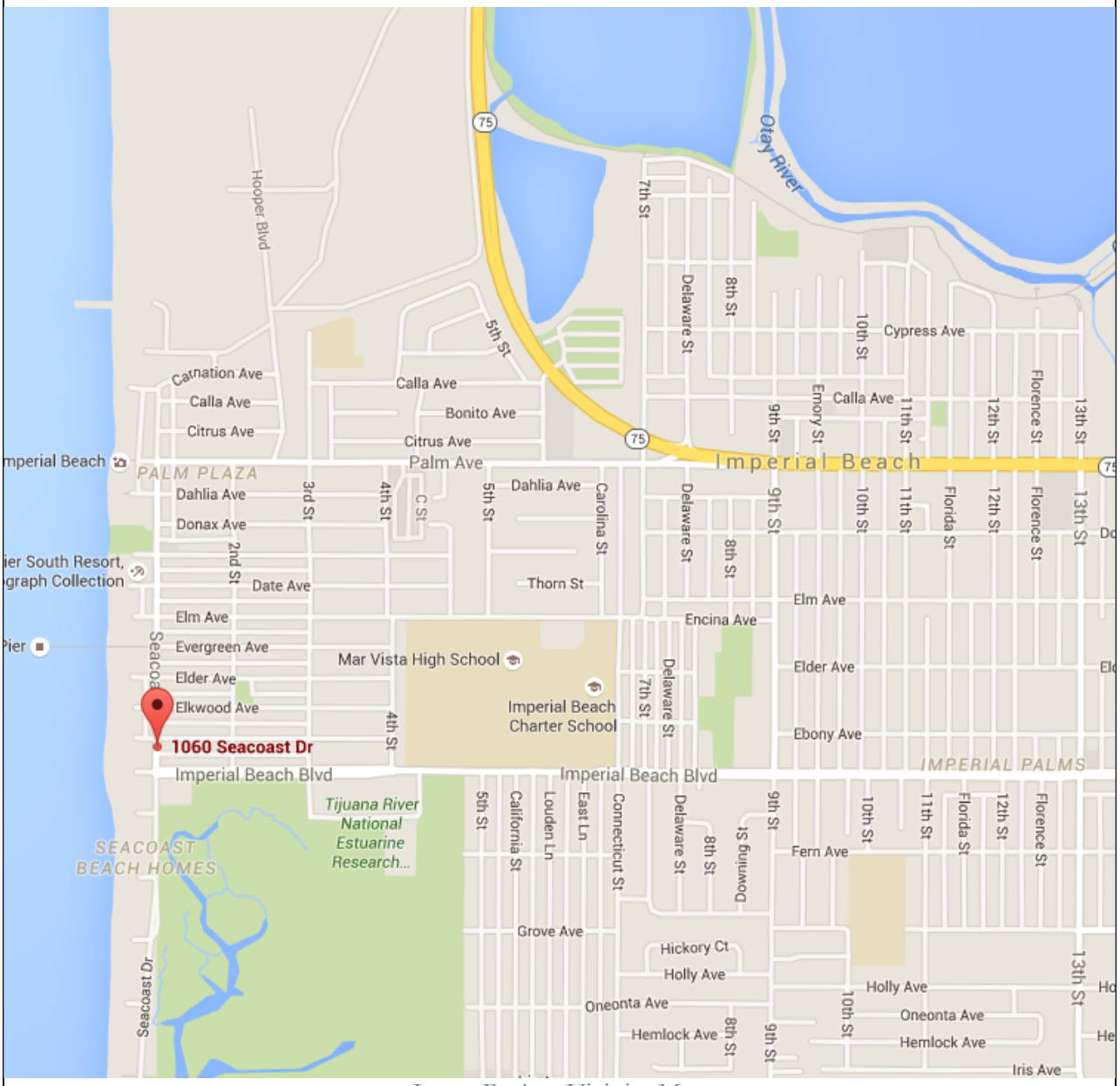
Project Name: **Imperial Beach Resort**

PROJECT VICINITY MAP

Project Name: **Imperial Beach Resort**
Permit Application Number:



Insert Project Vicinity Map

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Project Name: Imperial Beach Resort

Applicability of Permanent, Post-Construction Storm Water BMP Requirements (Storm Water Intake Form for all Development Permit Applications)		**Form I-1**
Project Identification		
Project Name: Imeprial Beach Resort		
Permit Application Number:		Date: 2/15/17
Determination of Requirements		
The purpose of this form is to identify permanent, post-construction requirements that apply to the project. This form serves as a short summary of applicable requirements, in some cases referencing separate forms that will serve as the backup for the determination of requirements. Answer each step below, starting with Step 1 and progressing through each step until reaching "Stop". Refer to Part 1 of Storm Water Standards sections and/or separate forms referenced in each step below.		
Step	Answer	Progression
Step 1: Is the project a "development project"? See Section 1.3 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☒Yes	Go to Step 2.
	☐No	Stop. Permanent BMP requirements do not apply. No SWQMP will be required. Provide discussion below.
Discussion / justification if the project is not a "development project" (e.g., the project includes only interior remodels within an existing building): Click or tap here to enter text.		
Step 2: Is the project a Standard Project, Priority Development Project (PDP), or exception to PDP definitions? To answer this item, see Section 1.4 of the BMP Design Manual (Part 1 of Storm Water Standards) in its entirety for guidance, AND complete Storm Water Requirements Applicability Checklist.	☐Standard Project	Stop. Standard Project requirements apply.
	☒PDP	PDP requirements apply, including PDP SWQMP. Go to Step 3.
	☐PDP Exempt	Stop. Standard Project requirements apply. Provide discussion and list any additional requirements below.
Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable: Click or tap here to enter text.		

Project Name: Imperial Beach Resort

Form I-1 Page 2		
Step	Answer	Progression
Step 3. Is the project subject to earlier PDP requirements due to a prior lawful approval? See Section 1.10 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☐Yes	Consult the City Engineer to determine requirements. Provide discussion and identify requirements below. Go to Step 4.
	☒No	BMP Design Manual PDP requirements apply. Go to Step 4.
Discussion / justification of prior lawful approval, and identify requirements (not required if prior lawful approval does not apply): Click or tap here to enter text.		
Step 4. Do hydromodification control requirements apply? See Section 1.6 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☐Yes	PDP structural BMPs required for pollutant control (Chapter 5) and hydromodification control (Chapter 6). Go to Step 5.
	☒No	Stop. PDP structural BMPs required for pollutant control (Chapter 5) only. Provide brief discussion of exemption to hydromodification control below.
Discussion / justification if hydromodification control requirements do not apply: The project discharges directly into the Pacific Ocean which is an Exempt system.		
Step 5. Does protection of critical coarse sediment yield areas apply? See Section 6.2 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☐Yes	Management measures required for protection of critical coarse sediment yield areas (Chapter 6.2). Stop.
	☒No	Management measures not required for protection of critical coarse sediment yield areas. Provide brief discussion below. Stop.
Discussion / justification if protection of critical coarse sediment yield areas does not apply: Project does not disturb areas designated as supplying critical coarse sediment		

Project Name: Imperial Beach Resort

Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	Imperial Beach Resort
Project Address	1060 Seacoast Blvd., Imperial Beach, CA, 91932
Assessor's Parcel Number(s) (APN(s))	625-380-27-00
Permit Application Number	
Project Watershed	Select One: ☐San Dieguito River ☐Penasquitos ☐Mission Bay ☐San Diego River ☐San Diego Bay ☒Tijuana River
Hydrologic subarea name with Numeric Identifier up to two decimal places (9XX.XX)	911.11
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	1.00 Acres (Square Feet)
Area to be disturbed by the project (Project Footprint)	1.00 Acres (43,536 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	0.97 Acres (42,030 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	0.03 Acres (1,506 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Project Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition.	19%

Project Name: Imperial Beach Resort

Form I-3B Page 2 of 11
Description of Existing Site Condition and Drainage Patterns
Current Status of the Site (select all that apply): ☒ Existing development ☒ Previously graded but not built out ☐ Agricultural or other non-impervious use ☐ Vacant, undeveloped/natural Description / Additional Information: The site currently consists of a graded site that has been prepared for the future hotel. There is a single building on-site with surface parking for the residence.
Existing Land Cover Includes (select all that apply): ☐ Vegetative Cover ☐ Non-Vegetated Pervious Areas ☒ Impervious Areas Description / Additional Information: The site is currently occupied by two office buildings and parking structures
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): ☐ NRCS Type A ☒ NRCS Type B ☐ NRCS Type C ☐ NRCS Type D
Approximate Depth to Groundwater (GW): ☐GW Depth < 5 feet ☒5 feet < GW depth < 10 feet ☐10 feet < GW Depth < 20 feet ☐GW Depth > 20 feet
Existing Natural Hydrologic Features (select all that apply): ☐ Watercourses ☐ Seeps ☐ Springs ☐ Wetlands ☒ None Description / Additional Information: No natural hydrologic features exist on the site

Form I-3B Page 3 of 11

Description of Existing Site Topography and Drainage:

How is storm water runoff conveyed from the site? At a minimum, this description should answer:

1. Whether existing drainage conveyance is natural or urban;
2. If runoff from offsite is conveyed through the site? If yes, quantification of all offsite drainage areas, design flows, and locations where offsite flows enter the project site and summarize how such flows are conveyed through the site;
3. Provide details regarding existing project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, and natural and constructed channels;
4. Identify all discharge locations from the existing project along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide summary of the pre-project drainage areas and design flows to each of the existing runoff discharge locations.

Description / Additional Information:

Currently (nor in the pre-demolition condition) there are no formal drainage improvements on site. Drainage from the project surface flows to all directions. Drainage from the project drains to the surrounding streets and also the beach.

Project Name: Imperial Beach Resort

Form I-3B Page 4 of 11
Description of Proposed Site Development and Drainage Patterns
Project Description / Proposed Land Use and/or Activities: The project proposes the construction of a 100 room hotel with underground parking. The project also proposes new underground utility services and access drives for the underground parking. This project proposes new water and sewer services as well as fire services. Storm water features include the addition of a modular wetland system, per BF-3 of the BMP Design Manual, as well as a storage tank and a pump system to discharge the storm water after treatment.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): The projects impervious areas include the roof of the proposed hotel and surrounding hardscape. Impervious features also include the project entry and sidewalks. All impervious areas drain to the storm water tank, and are treated prior to discharge.
List/describe proposed pervious features of the project (e.g., landscape areas): The site will feature ornamental landscape areas throughout the site. Landscape areas are located around the perimeter of the site, and within the courtyard of the hotel. Because of the small footprint of the site, there is limited room for landscaping. In addition, a high water table (due to close proximity of the ocean) makes landscaping more difficult than on a traditional site.
Does the project include grading and changes to site topography? ☒Yes ☐No Description / Additional Information: The site has been previously graded for construction of the hotel. The project proposes the excavation of a large basement for the addition of the parking garage.

Form I-3B Page 5 of 11

Does the project include changes to site drainage (e.g., installation of new storm water conveyance systems)?

☒Yes

☐No

If yes, provide details regarding the proposed project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural and constructed channels, and the method for conveying offsite flows through or around the proposed project site. Identify all discharge locations from the proposed project site along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide a summary of pre and post-project drainage areas and design flows to each of the runoff discharge locations. Reference the drainage study for detailed calculations.

Description / Additional Information:

In the proposed condition, drainage will be collected in a series of catch basins and roof drains. Sidewalks along the perimeter of the site will be tipped towards the project, and will be collected within the project boundary. At the top and bottom of the entrance ramp, a trench drain is proposed. This trench drain will pick up all storm flows from the entrance ramp and route them to the storage tank and treatment. At the entry drive, two trench drains are proposed.

These trench drains will pick up the drainage from the entry drive and route it to the storage tank and the MWS treatment.

Drainage will be routed to the parking garage where the flows will enter a storage tank. The flows from the storage tank will gravity flow through a modular wetland system (Proprietary Biofiltration Unit, per BF-3), before being discharge a curb outlet pipe at the southwest corner of the site Imperial Beach Ave. These flows will comingle with the public drainage before discrging onto the public beach.

Because there is no storm draina available to tie in to adjacent to the site, the site will discharge via a sidewalk inderdrain pipe. It is our understanding that the City of Imperial Beach does not typically allow curb outlet pipes. However, this project will be asking for a design exception to allow the curb outlet pipe.

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Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply):

☒ On-site storm drain inlets
☒ Interior floor drains and elevator shaft sump pumps
☒ Interior parking garages
☒ Need for future indoor & structural pest control
☒ Landscape/Outdoor Pesticide Use
☐ Pools, spas, ponds, decorative fountains, and other water features
☐ Food service
☒ Refuse areas
☐ Industrial processes
☐ Outdoor storage of equipment or materials
☐ Vehicle and Equipment Cleaning
☐ Vehicle/Equipment Repair and Maintenance
☐ Fuel Dispensing Areas
☐ Loading Docks
☐ Fire Sprinkler Test Water
☒ Miscellaneous Drain or Wash Water
☒ Plazas, sidewalks, and parking lots
☐ Large Trash Generating Facilities
☐ Animal Facilities
☐ Plant Nurseries and Garden Centers
☒ Automotive-related Uses

Description / Additional Information:

Click or tap here to enter text.

Project Name: Imperial Beach Resort

Form I-3B Page 7 of 11
Identification and Narrative of Receiving Water
Narrative describing flow path from discharge location(s), through urban storm conveyance system, to receiving creeks, rivers, and lagoons and ultimate discharge location to Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable) In the proposed condition, drainage will be collected in a series of catch basins and roof drains. Drainage will be routed to the parking garage where the flows will enter a storage tank. The flows from the storage tank will gravity flow through a modula4r wetland system (Proprietary Biofiltration Unit), before being discharge to curb outlet at the northwest corner of the site onto Imperial Beach Blvd. From Imperial Beach Blvd., storm water comingles with street drainage before discharging to the beach. Drainage from the public sidewalks and surrounding public hardscape will continue to flow into the adjacent streets and flow untreated into the gutter before being discharged to the Pacific Ocean.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations. IND NAV REC1 REC2 COMM BIOL WILD RARE MAR MIGR SPWN SHELL
Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations. The project does not drain to an ASBS
Provide distance from project outfall location to impaired or sensitive receiving waters. Approximately 100 yards.
Sumarize information regarding the proximity of the permanent, post-construction storm water BMPs to the City's environmentally sensitive lands Approximately 2 miles.

Project Name: Imperial Beach Resort

Form I-3B Page 8 of 11		
Identification of Receiving Water Pollutants of Concern		
List any 303(d) impaired water bodies within the path of storm water from the project site to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable), identify the pollutant(s)/stressor(s) causing impairment, and identify any TMDLs and/or Highest Priority Pollutants from the WQIP for the impaired water bodies:		
303(d) Impaired Water Body	Pollutant(s)/Stressor(s)	TMDLs/ WQIP Highest Priority Pollutant

Identification of Project Site Pollutants*			
*Identification of project site pollutants is only required if flow-thru treatment BMPs are implemented onsite in lieu of retention or biofiltration BMPs (note the project must also participate in an alternative compliance program unless prior lawful approval to meet earlier PDP requirements is demonstrated) Identify pollutants anticipated from the project site based on all proposed use(s) of the site (see BMP Design Manual (Part 1 of Storm Water Standards) Appendix B.6):			
Pollutant	Not Applicable to the Project Site	Anticipated from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment	☐	☐	☐
Nutrients	☐	☐	☐
Heavy Metals	☐	☐	☐
Organic Compounds	☐	☐	☐
Trash & Debris	☐	☐	☐
Oxygen Demanding Substances	☐	☐	☐
Oil & Grease	☐	☐	☐
Bacteria & Viruses	☐	☐	☐
Pesticides	☐	☐	☐

Project Name: Imperial Beach Resort

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Hydromodification Management Requirements

Do hydromodification management requirements apply (see Section 1.6 of the BMP Design Manual)?

☐ Yes, hydromodification management flow control structural BMPs required.

☒ No, the project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.

☐ No, the project will discharge runoff directly to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.

☐ No, the project will discharge runoff directly to an area identified as appropriate for an exemption by the WMAA for the watershed in which the project resides.

Description / Additional Information (to be provided if a 'No' answer has been selected above):
Project discharges onto Ebony street which drains directly to the Pacfic Ocean.

Critical Coarse Sediment Yield Areas*
*This Section only required if hydromodification management requirements apply

Based on Section 6.2 and Appendix H does CCSYA exist on the project footprint or in the upstream area draining through the project footprint?

☐ Yes

☒ No, No critical coarse sediment yield areas to be protected based on WMAA maps

Discussion / Additional Information:
Refer to WMAA map exhibit

Project Name: Imperial Beach Resort

Form I-3B Page 10 of 11
Flow Control for Post-Project Runoff* *This Section only required if hydromodification management requirements apply
List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project's HMP Exhibit. This project is exepemt from Hydromodifcation because of direct discrge to an exempt water body, the Pacific Ocean.
Has a geomorphic assessment been performed for the receiving channel(s)? ☐ No, the low flow threshold is 0.1Q2 (default low flow threshold) ☐ Yes, the result is the low flow threshold is 0.1Q2 ☐ Yes, the result is the low flow threshold is 0.3Q2 ☐ Yes, the result is the low flow threshold is 0.5Q2 If a geomorphic assessment has been performed, provide title, date, and preparer: Click or tap here to enter text.
Discussion / Additional Information: (optional) Click or tap here to enter text.

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Other Site Requirements and Constraints
When applicable, list other site requirements or constraints that will influence storm water management design, such as zoning requirements including setbacks and open space, or local codes governing minimum street width, sidewalk construction, allowable pavement types, and drainage requirements. The major design considerations for the BMP's is the elevation of the water table and the proximity of the pacific ocean.
Optional Additional Information or Continuation of Previous Sections As Needed
This space provided for additional information or continuation of information from previous sections as needed. Click or tap here to enter text.

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Project Name: Imperial Beach Resort

Source Control BMP Checklist for All Development Projects	Form I-4

Source Control BMPs

All development projects must implement source control BMPs SC-1 through SC-6 where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of the Storm Water Standards) for information to implement source control BMPs shown in this checklist.

Answer each category below pursuant to the following.

- "Yes" means the project will implement the source control BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project has no outdoor materials storage areas). Discussion / justification may be provided.

Source Control Requirement	Applied?		
SC-1 Prevention of Illicit Discharges into the MS4	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-1 not implemented: Project does not discharge into MS4			
SC-2 Storm Drain Stenciling or Signage	☒ Yes	☐ No	☐ N/A
Discussion / justification if SC-2 not implemented:			
SC-3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-3 not implemented:			
SC-4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-4 not implemented:			
SC-5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-5 not implemented:			

Project Name: Imperial Beach Resort

Form I-4 Page 2 of 2			
Source Control Requirement	Applied?		
SC-6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)			
On-site storm drain inlets	☒ Yes	☐ No	☐ N/A
Interior floor drains and elevator shaft sump pumps	☒ Yes	☐ No	☐ N/A
Interior parking garages	☒ Yes	☐ No	☐ N/A
Need for future indoor & structural pest control	☒ Yes	☐ No	☐ N/A
Landscape/Outdoor Pesticide Use	☒ Yes	☐ No	☐ N/A
Pools, spas, ponds, decorative fountains, and other water features	☐ Yes	☐ No	☒ N/A
Food service	☐ Yes	☐ No	☒ N/A
Refuse areas	☒ Yes	☐ No	☐ N/A
Industrial processes	☐ Yes	☐ No	☒ N/A
Outdoor storage of equipment or materials	☐ Yes	☐ No	☒ N/A
Vehicle/Equipment Repair and Maintenance	☐ Yes	☐ No	☒ N/A
Fuel Dispensing Areas	☐ Yes	☐ No	☒ N/A
Loading Docks	☐ Yes	☐ No	☒ N/A
Fire Sprinkler Test Water	☒ Yes	☐ No	☐ N/A
Miscellaneous Drain or Wash Water	☒ Yes	☐ No	☐ N/A
Plazas, sidewalks, and parking lots	☒ Yes	☐ No	☐ N/A
SC-6A: Large Trash Generating Facilities	☐ Yes	☐ No	☒ N/A
SC-6B: Animal Facilities	☐ Yes	☐ No	☒ N/A
SC-6C: Plant Nurseries and Garden Centers	☐ Yes	☐ No	☒ N/A
SC-6D: Automotive-related Uses	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for all "No" answers shown above.			

Project Name: Imperial Beach Resort

Site Design BMP Checklist for All Development Projects	Form I-5

Site Design BMPs

All development projects must implement site design BMPs SD-1 through SD-8 where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of Storm Water Standards) for information to implement site design BMPs shown in this checklist.

Answer each category below pursuant to the following.

- "Yes" means the project will implement the site design BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project site has no existing natural areas to conserve). Discussion / justification may be provided.

A site map with implemented site design BMPs must be included at the end of this checklist.

Site Design Requirement	Applied?		
SD-1 Maintain Natural Drainage Pathways and Hydrologic Features	☒ Yes	☐ No	☐ N/A
Discussion / justification if SD-1 not implemented:			
1-1 Are existing natural drainage pathways and hydrologic features mapped on the site map?	☒ Yes	☐ No	☐ N/A
1-2 Are street trees implemented? If yes, are they shown on the site map?	☐ Yes	☐ No	☒ N/A
1-3 Implemented street trees meet the design criteria in SD-1 Fact Sheet (e.g. soil volume, maximum credit, etc.)?	☐ Yes	☐ No	☒ N/A
1-4 Is street tree credit volume calculated using Appendix B.2.2.1 and SD-1 Fact Sheet in Appendix E?	☐ Yes	☐ No	☒ N/A
SD-2 Have natural areas, soils and vegetation been conserved?	☒ Yes	☐ No	☐ N/A
Discussion / justification if SD-2 not implemented:			

Project Name: Imperial Beach Resort

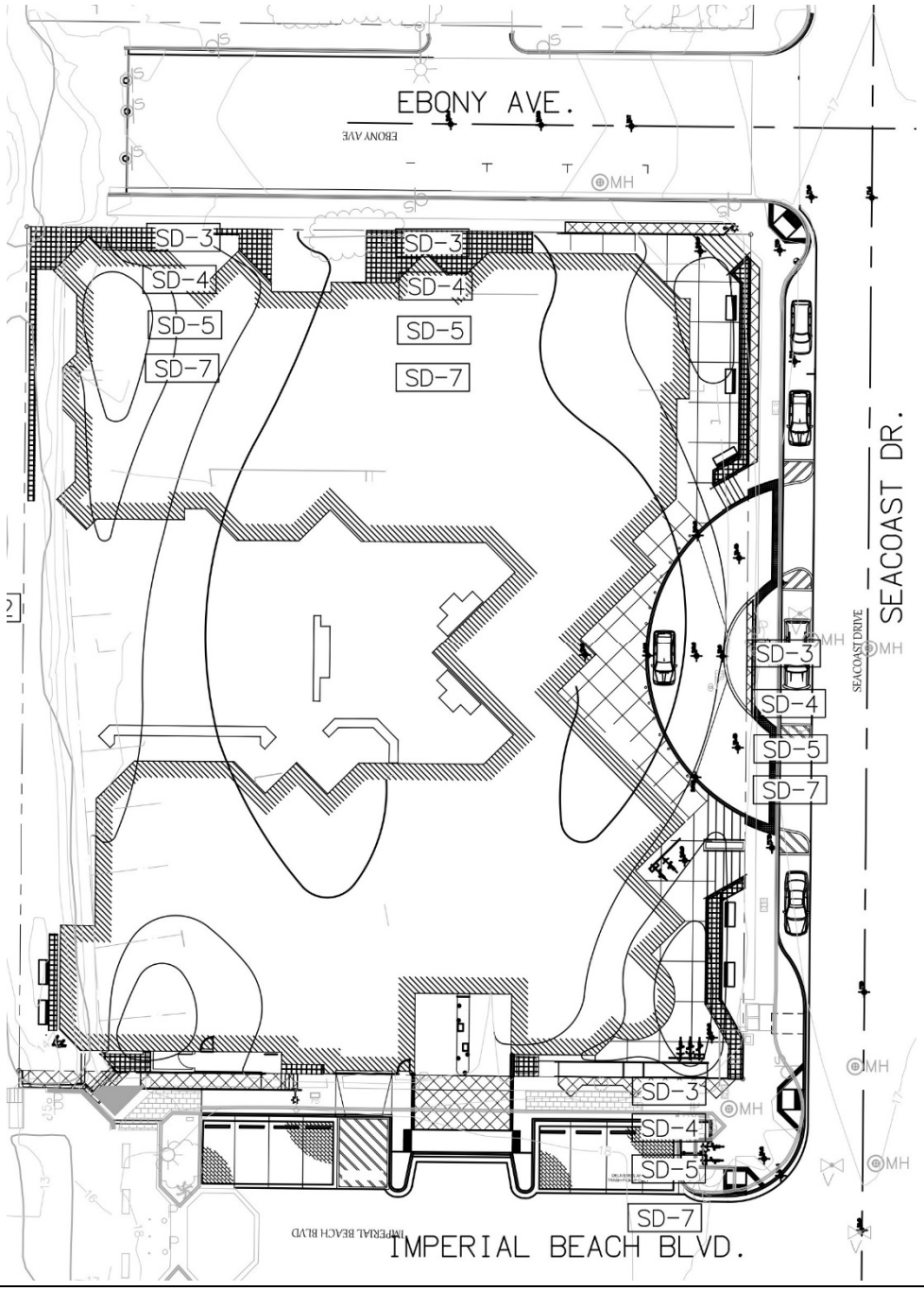
Form I-5 Page 2 of 4			
Site Design Requirement	Applied?		
SD-3 Minimize Impervious Area	☒ Yes	☐ No	☐ N/A
Discussion / justification if SD-3 not implemented:			
SD-4 Minimize Soil Compaction	☒ Yes	☐ No	☐ N/A
Discussion / justification if SD-4 not implemented:			
SD-5 Impervious Area Dispersion	☐ Yes	☐ No	☒ N/A
Discussion / justification if SD-5 not implemented: Small site area does not allow for drainage into pervious area before discharge from the site.			
5-1 Is the pervious area receiving runon from impervious area identified on the site map?	☐ Yes	☒ No	
5-2 Does the pervious area satisfy the design criteria in SD-5 Fact Sheet in Appendix E (e.g. maximum slope, minimum length, etc.)	☐ Yes	☒ No	
5-3 Is impervious area dispersion credit volume calculated using Appendix B.2.1.1 and SD-5 Fact She et in Appendix E?	☐ Yes	☒ No	

Project Name: Imperial Beach Resort

Form I-5 Page 3 of 4			
Site Design Requirement	Applied?		
SD-6 Runoff Collection	☐ Yes	☒ No	☐ N/A
Discussion / justification if SD-6 not implemented: Due to the rainy season not coinciding with the busy season for tourism, there is not sufficient demand for water collection to justify implementation.			
6a-1 Are green roofs implemented in accordance with design criteria in SD-6A Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☐ N/A
6a-2 Is green roof credit volume calculated using Appendix B.2.1.2 and SD-6A Fact Sheet in Appendix E?	☐ Yes	☐ No	☐ N/A
6b-1 Are permeable pavements implemented in accordance with design criteria in SD-6B Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☐ N/A
6b-2 Is permeable pavement credit volume calculated using Appendix B.2.1.3 and SD-6B Fact Sheet in Appendix E?	☐ Yes	☐ No	☐ N/A
SD-7 Landscaping with Native or Drought Tolerant Species	☒ Yes	☐ No	☐ N/A
Discussion / justification if SD-7 not implemented:			
SD-8 Harvesting and Using Precipitation	☐ Yes	☒ No	☐ N/A
Discussion / justification if SD-8 not implemented: Due to the rainy season not coinciding with the busy season for tourism, there is not sufficient demand for water collection to justify harvest.			
8-1 Are rain barrels implemented in accordance with design criteria in SD-8 Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☒ N/A
8-2 Is rain barrel credit volume calculated using Appendix B.2.2.2 and SD-8 Fact Sheet in Appendix E?	☐ Yes	☐ No	☒ N/A

Project Name: Imperial Beach Resort

Form I-5 Page 4 of 4
Insert Site Map with all site design BMPs identified:



Project Name: Imperial Beach Resort

Summary of PDP Structural BMPs	Form I-6

PDP Structural BMPs

All PDPs must implement structural BMPs for storm water pollutant control (see Chapter 5 of the BMP Design Manual, Part 1 of Storm Water Standards). Selection of PDP structural BMPs for storm water pollutant control must be based on the selection process described in Chapter 5. PDPs subject to hydromodification management requirements must also implement structural BMPs for flow control for hydromodification management (see Chapter 6 of the BMP Design Manual). Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s).

PDP structural BMPs must be verified by the City at the completion of construction. This includes requiring the project owner or project owner's representative to certify construction of the structural BMPs (complete Form DS-563). PDP structural BMPs must be maintained into perpetuity (see Chapter 7 of the BMP Design Manual).

Use this form to provide narrative description of the general strategy for structural BMP implementation at the project site in the box below. Then complete the PDP structural BMP summary information sheet (page 3 of this form) for each structural BMP within the project (copy the BMP summary information page as many times as needed to provide summary information for each individual structural BMP).

Infiltration is always our first choice for storm water. It is inexpensive, efficient and the preffered method. An analysis of the site showed that the entire site was underlain by beack sand and it was anticipated that the ground water would be less than 5 feet below any infiltration facility. In aaddition, with the high ground water and loosely consolidated soils, there is a high risk of liquesfaction with the addition of additional water into the subgrade.

Because of the no-infiltration condition due to high ground water and geologic hazards, we decided to pursue Biofiltration. The permit list several types of biofiltration that are acceptable, and so for this project we chose the BF-3, proprietary Biofiltration device. The MWS system is a TAPE approved system that is used through the United States.

The entire site proposes to drain to a treatment control facility located within the basement of the facility. The treatment facility includes a tank that can retain the 85th percentile rainfall, as well as a Modular Wetland System and a wet well. The proposed detention n facility has been sized to store the 85th percentile runoff which is equal to 0.55" or approximately 20,000 gallons. This tank discharges to a modular wetland system, before being discharged to the wet well. Flows are then pumped from the wet well to the northwest corner of the site where they are discharged from the site via a curb outlet.

Calculations show that the 100-year flow is able to be routed through this system with the tank not overflowing. This will require a duplex pumping system, with 2 pumps each capable of pumping 60 gallons per minute. The system will pump at the 120 gpm rate only during heavy rains when the tank is over 50% full.

(Continue on page 2 as necessary.)

Project Name: Imperial Beach Resort

Form I-6
(Page reserved for continuation of description of general strategy for structural BMP implementation at the site)
(Continued from page 1)

Project Name: Imperial Beach Resort

Form I-6 Page 1 of 2 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BF-1	
Construction Plan Sheet No.	
Type of structural BMP: ☐Retention by Harvest and use HU-1 ☐Retention by infiltration basin (NF-1) ☐Retention by bioretention (INF-2) ☐Retention by permeable pavement (INF-3) ☐Partial retention by biofiltration with partial retention (PR-1) ☒Biofiltration (BF-1) ☐Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide (BMP type / description in discussion below) ☐Flow-thru treatment control included as pre-treatment / forebay for an onsite retention of biofiltration BMP (provide BNP type / description and indicate which onsite retention or biofiltration BMP it serves in discussion section below. ☐Flow-thru treatment control with alternative compliance (provide BMP type / description in) ☐Detention pond of vault for hydromodification management ☐Other (describe in discussion section below)	
Purpose: ☒Pollutant control only ☐Hydromodification control only ☐Combined pollutant control and hydromodification control ☐Pre-treatment / forebay for another structural BMP ☐Other (descibe in discussion below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification form DS-563	Richard Tomlinson, Jr. Project Engineer
Who will be the final owner of this BMP?	Imperial Beach Resort, LLC
Who will maintain this BMP into perpetuity?	Imperial Beach Resort, LLC
What is the funding mechanism for maintenance?	Owners on-going maintenance funding

Project Name: Imperial Beach Resort

Form I-6 Page 2 of 2 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. Underground Vault	
Construction Plan Sheet No.	
Type of structural BMP: ☐Retention by Harvest and use HU-1 ☐Retention by infiltration basin (NF-1) ☐Retention by bioretention (INF-2) ☐Retention by permeable pavement (INF-3) ☐Partial retention by biofiltration with partial retention (PR-1) ☐Biofiltration (BF-1) ☐Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide (BMP type / description in discussion below) ☐Flow-thru treatment control included as pre-treatment / forebay for an onsite retention of biofiltration BMP (provide BNP type / description and indicate which onsite retention or biofiltration BMP it serves in discussion section below. ☐Flow-thru treatment control with alternative compliance (provide BMP type / description in) ☒Detention pond of vault for hydromodification management ☐Other (describe in discussion section below)	
Purpose: ☐Pollutant control only ☐Hydromodification control only ☐Combined pollutant control and hydromodification control ☒Pre-treatment / forebay for another structural BMP ☐Other (descibe in discussion below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification form DS-563	Richard Tomlinson, Jr. Project Engineer
Who will be the final owner of this BMP?	Imperial Beach Resort, LLC
Who will maintain this BMP into perpetuity?	Imperial Beach Resort, LLC
What is the funding mechanism for maintenance?	Owners on-going maintenance funding

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ATTACHMENT 1
BACKUP FOR PDP POLLUTANT CONTROL BMPS

This is the cover sheet for Attachment 1.

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Project Name: Imperial Beach Resort

Indicate which Items are Included:

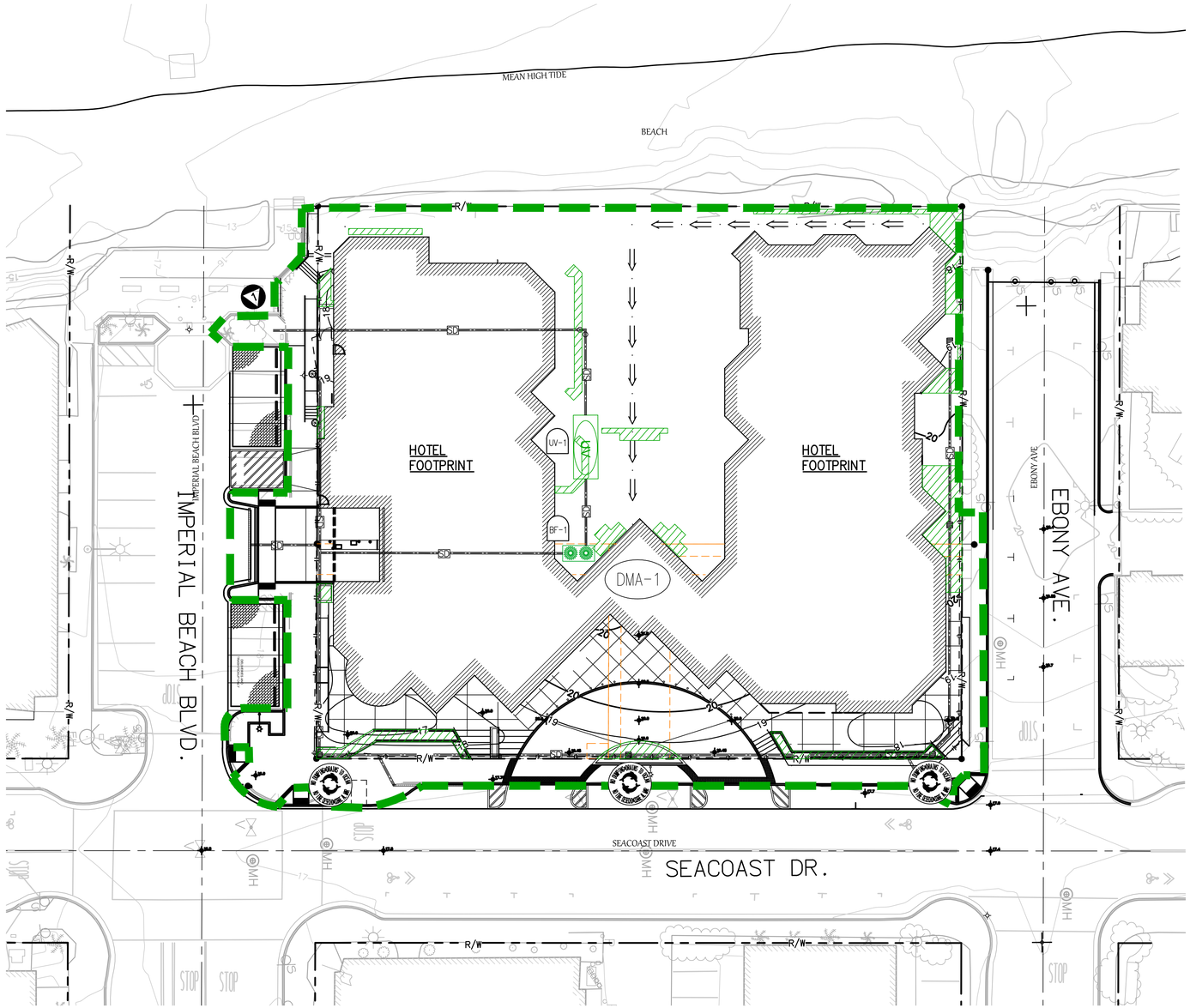
Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☒ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☒Included on DMA Exhibit in Attachment 1a ☐Included as Attachment 1b, separate from DMA Exhibit
Attachment 1c	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☒Included ☐Not included because the entire project will use harvest and use BMPs
Attachment 1d	Form I-8, Categorization of Infiltration Feasibility Condition (Required unless the project will use harvest and use BMPs) Refer to Appendices C and D of the BMP Design Manual to complete Form I-8.	☒Included ☐Not included because the entire project will use infiltration BMPs
Attachment 1e	Pollutant Control BMP Design Worksheets / Calculations (Required) Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines and site design credit calculations	☒ Included

Project Name: Imperial Beach Resort

Use this checklist to ensure the required information has been included on the DMA Exhibit:

The DMA Exhibit must identify:

☒ Underlying hydrologic soil group
☒ Approximate depth to groundwater
☒ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
☒ Critical coarse sediment yield areas to be protected
☒ Existing topography and impervious areas
☒ Existing and proposed site drainage network and connections to drainage offsite
☒ Proposed grading
☒ Proposed impervious features
☒ Proposed design features and surface treatments used to minimize imperviousness
☒ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
☒ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
☒ Structural BMPs (identify location, type of BMP, and size/detail)



SCALE: 1"=20'

20 0 20 40 60

SCALE: 1"=20'

LEGEND

- LIMITS OF OVERALL DRAINAGE BASIN
- FLOW DIRECTION
- DMA ID NUMBER — DMA-#
- PERVIOUS AREA
- BMP ID — XXX-#
- POINT OF COMPLIANCE
- STORMWATER STORAGE TANK — UV
- STORM DRAIN STENCILING

NOTES

NO NATURAL HYDROLOGIC FEATURES CURRENTLY EXIST ON SITE

ALL SOILS URBAN LANDS SOIL TYPE "B"

GROUNDWATER DEPTH EXCEEDS > 8 FEET

NO CRITICAL COARSE SEDIMENT YIELD AREAS EXIST ON SITE. SEE ATTACHMENT 2b FOR AN EXPANDED EXHIBIT

DMA SUMMARY

DMA ID	DMA AREA (AC)	TYPE	BMP AREA (AC)
DMA-1	1.00	DRAINS TO MWS	8'x16'

IMPERVIOUS/PERVIOUS AREA (ACRES) TABLE

	IMPERVIOUS (AC)	PERVIOUS (AC)	TOTAL (AC)
DMA-1	0.97	0.03	1.00
Total	0.97	0.03	1.00

Imperial Beach Resort

DMA Map

02/15/2017

Michael Baker INTERNATIONAL
9755 Clairemont Mesa Boulevard
San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

Harvest and Use Feasibility Checklist	Form I-7

1. Is there a demand for harvested water (check all that apply) at the project site that is reliably present during the wet season?

☐ Toilet and urinal flushing
☐ Landscape irrigation
☐ Other:_____

The facilities are a seasonal facility with most use during times with good weather and very little use when there is rain. Therefore, there is no reliably present use during the wet season.

2. If there is a demand; estimate the anticipated average wet season demand over a period of 36 hours. Guidance for planning level demand calculations for toilet/urinal flushing and landscape irrigation is provided in Section B.3.2.

[Provide a summary of calculations here]

3. Calculate the DCV using worksheet B-2.1.

DCV = _____ (cubic feet)

3a. Is the 36 hour demand greater than or equal to the DCV?	3b. Is the 36 hour demand greater than 0.25DCV but less than the full DCV?	3c. Is the 36 hour demand less than 0.25DCV?
☐ Yes / ☐ No ⇨ ⇩	☐ Yes / ☐ No ⇨ ⇩	☐ Yes ⇩
Harvest and use appears to be feasible. Conduct more detailed evaluation and sizing calculations to confirm that DCV can be used at an adequate rate to meet drawdown criteria.	Harvest and use may be feasible. Conduct more detailed evaluation and sizing calculations to determine feasibility. Harvest and use may only be able to be used for a portion of the site, or (optionally) the storage may need to be upsized to meet long term capture targets while draining in longer than 36 hours.	Harvest and use is considered to be infeasible.

Is harvest and use feasible based on further evaluation?

☐ Yes, refer to Appendix E to select and size harvest and use BMPs.

☐ No, select alternate BMPs.

Categorization of Infiltration Feasibility Condition		**Form I-8**	
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	X	
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X
Provide basis: Infiltration increases the risk of liquesfaction at the site. Site soils are saturated granualr sand which are susceptable to liquesfaction. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Form I-8 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		X
Provide basis: The water table is between 5 and 10 feet BGL. Becuase of the high water table, storm flows would not be treated prior to entering ground water. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	x	
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		No

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

Form I-8 Page 3 of 4			
Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	X	
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X
Provide basis: See above. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			

Form I-8 Page 4 of 4			
Criteria	Screening Question	Yes	No
7	Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		X
Provide basis: See above. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	x	
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration. If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.		No

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

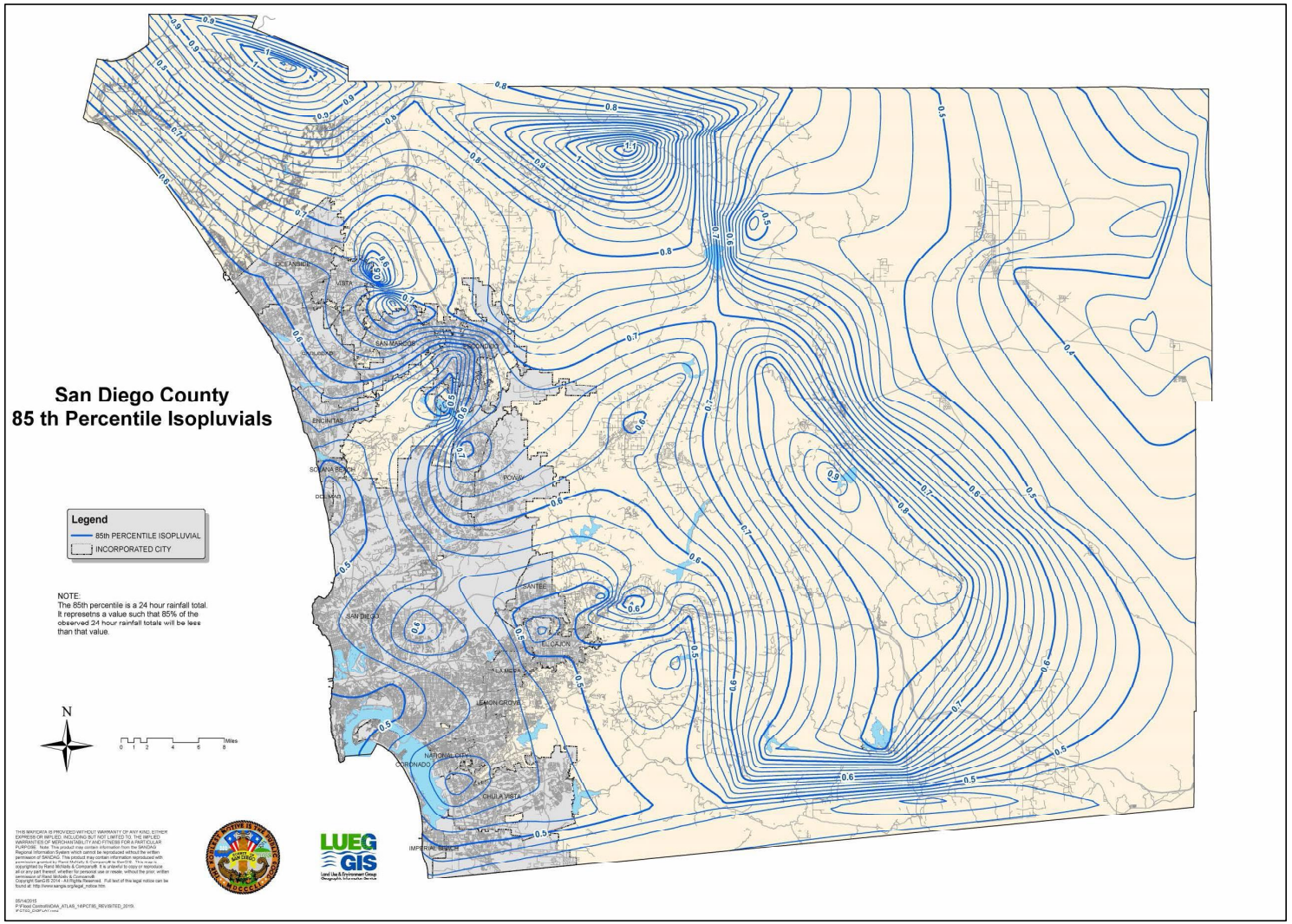


Figure B.1-1: 85th Percentile 24-hour Isopluvial Map

DMA-1

Design Capture Volume		Worksheet B-2.1		
1	85th Percentile 24-hr storm depth from Figure B.1-1	d=	0.5	inches
2	Areas tributary to BMP(s)	A=	1.00	acres
3	Runoff Factor	C=	0.82	unitless
4	Street Trees Reduction Volume	TCV=	0	cubic-feet
5	Rain Barrels Reduction Volume	RCV=	0	cubic-feet
6	Calculated DCV	DCV=	1488.30	cubic-feet

DMA-1

Flow-thru Design Flows		Worksheet B.6-1		
1	DCV	DCV	1488.30	cubic-feet
2	DCV retained	$DCV_{retained}$	0	cubic-feet
3	DCV biofiltered	$DCV_{biofiltered}$	0	cubic-feet
4	DCV requiring flow-thru (Line 1 - Line 2 - 0.67*Line 3)	$DCV_{flow-thru}$	1488.30	cubic-feet
5	Adjustment factor (Line 4 / Line 1)	AF=	1	unitless
6	Design rainfall intensity	i=	0.2	in/hr
7	Area tributary to BMP (s)	A=	1	acres
8	Runoff Factor	C=	0.82	unitless
9	Calculate Flow Rate = AF x (C x i x A)	Q=	0.164	cfs

Modular Wetlands System 4'x15' has a flow treatment rate of 0.175 cfs which exceeds the treatment flow rate calculated above.

April 20th, 2016

Project: All Related

Subject: MWS Linear BMP Classification Per San Diego Manual

To Whom It May Concern:

It is the intention of this document to use the MWS Linear as a biofiltration BMP. Based upon definitions of Biofiltration as found in Section 2.2.1 and Appendix F of the manual the MWS Linear meets the criteria to be classified as biofiltration and therefore is not flow through treatment and thus does not trigger the need for alternative compliance. The MWS Linear has GULD approval for basic, phosphorus and enhanced treatment under the TAPE approval. The system is certified under the TAPE approval at a loading rate of 1 gpm/sq ft for all three pollutant categories. This is consistent with the performance criteria related to the performance of Appendix F.

Let us first address the comment regarding the MWS (referring to the Modular Wetland System Linear) being flow through treatment. To do so let us look at the definition of biofiltration as provided by the Design Manual which states:

> *"For situations where onsite retention of the 85th percentile storm volume is not feasible, biofiltration must be provided to satisfy specific "biofiltration standards" i.e. a set of selection, sizing, design and operation and maintenance (O&M) criteria that must be met for a BMP to be considered a "biofiltration BMP" – see Section 2.2.1 and Appendix F."*

If we look at section 2.2.2 Storm Water Pollutant Control Performance Standard it states:

> *"(i) If it is not technically feasible to implement retention BMPs for the full DCV onsite for a PDP, then the PDP shall utilize biofiltration BMPs for the remaining volume not reliably retained. Biofiltration BMPs must be designed as described in Appendix F to have an appropriate hydraulic loading rate to maximize storm water retention and pollutant removal, as well as to prevent erosion, scour, and channeling within the BMP, and must be sized to:*
>
> > *[a]. Treat 1.5 times the DCV not reliably retained onsite, OR*
> >
> > *[b]. Treat the DCV not reliably retained onsite with a flow-thru design that has a total volume, including pore spaces and pre-filter detention volume, sized to hold at least 0.75 times the portion of the DCV not reliably retained onsite."*

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As the manual states Biofiltration BMPs must be designed as described in Appendix F which states:

> *"A project applicant must be able to affirmatively demonstrate that a given BMP is designed and sized in a manner consistent with this definition to be considered as a "biofiltration BMP" as part of a compliant storm water management plan."*
>
> *"This appendix contains a checklist of the key underlying criteria that must be met for a BMP to be considered a biofiltration BMP. The purpose of this checklist is to facilitate consistent review and approval of biofiltration BMPs that meet the "biofiltration standard" defined by the MS4 Permit."*
>
> *"This checklist includes specific design criteria that are essential to defining a system as a biofiltration BMP; however it does not present a complete design basis. This checklist was used to develop BMP Fact Sheets for PR-1 biofiltration with partial retention and BF-1 biofiltration, which do present a complete design basis. Therefore, biofiltration BMPs that substantially meet all aspects of the Fact sheets PR-1 or BF-1 should be able to complete this checklist without additional documentation beyond what would already be required for a project submittal."*
>
> *"Other biofiltration BMP designs (including both non-proprietary and proprietary designs) may also meet the underlying MS4 Permit requirements to be considered biofiltration BMPs. These BMPs may be classified as biofiltration BMPs if they (1) meet the minimum design criteria listed in this appendix, including the pollutant treatment performance standard in Appendix F.1, (2) are designed and maintained in a manner consistent with their performance certifications (See explanation in Appendix F.2), if applicable, and (3) are acceptable at the discretion of the [City Engineer]. The applicant may be required to provide additional studies and/or required to meet additional design criteria beyond the scope of this document in order to demonstrate that these criteria are met."*

As stated the Biofiltration BMP must meet three objectives. The following outlines how the Modular Wetland System Linear meets these criteria.

Minimum Design Criteria

1. Biofiltration BMPs shall be allowed only as described in the BMP selection process in this manual (i.e., retention feasibility hierarchy).

    a. The Modular Wetland System Linear (MWS Linear) is only being proposed on plans when retention via infiltration or reuse is proven infeasible. Conditions such as soils with little to no infiltration rate or sites in which insufficient landscaping warrant to successful implementation of reuse systems.

2. Biofiltration BMPs must be sized using acceptable sizing methods described in this manual.

    a. Section B.5.2 Basis for Minimum Sizing Factor for Biofiltration BMPs states:

    "The MS4 Permit describes conceptual performance goals for biofiltration BMPs and specifies numeric criteria for sizing biofiltration BMPs (See Section 2.2.1 of this Manual). However, the MS4 Permit does not define a specific footprint sizing factor or design profile that must be provided for the BMP to be considered "biofiltration."

    "Additionally, it does not apply to alternative biofiltration designs that utilize the checklist in Appendix F (Biofiltration Standard and Checklist). Acceptable alternative designs (such as proprietary systems meeting Appendix F criteria) typically include design features intended to allow acceptable performance with a smaller footprint and have undergone field scale testing to evaluate performance and required O&M frequency."

    As stated in the Manual alternative biofiltration designs are allowed. The MWS Linear therefore qualifies as a biofiltration BMP under this definition as it has both undergone field scale testing (TAPE tested and approved with a GULD) and provides requirements on O&M frequency. In addition, the MWS Linear can be sized to treat either 1.5 times the DCV not reliably retained onsite OR 1.0 times the portion of the DCV not reliably retained onsite; and additionally check that the system has a total static (i.e. non-routed) storage volume, including pore spaces and pre-filter detention volume to at least 0.75 times the portion of the DCV not reliably retained onsite.

3. Biofiltration BMPs must be sited and designed to achieve maximum feasible infiltration and evapotranspiration.

    a. The MWS Linear is utilized and placed in the same manner as other types of biofiltration systems. As with other biofiltration systems the MWS Linear includes and underdrain for the remaining portion of the DCV that is not retained via incidental infiltration (as biofiltration if infiltration is not feasible due to poor soils) and evapotranspiration. The MWS Linear can be designed with an open bottom to maximize this incidental infiltration. The only exception to this, as with other biofiltration BMPs, is when the geotechnical consultant recommends an impervious liner be used due to specific soil conditions such as expansive clays. Additionally, the MWS Linear utilizes an amended media that is much more porous than the standard prescribed biofiltration media which is a mix of sand and compost. 100% of the media used in the MWS Linear has interparticle voids of 48% plus and 24% internal void space for each media particle. This is much greater than the sand which has interparticle voids of 35% and internal voids of 0%. As such, the MWS Linear retains greater moisture which allows for greater volume retention and ultimately evapotranspiration via respiration of the contained vegetation.

4. Biofiltration BMPs must be designed with a hydraulic loading rate to maximize pollutant retention, preserve pollutant control/sequestration processes, and minimize potential for pollutant washout.

    a. The manual states:

    "Alternatively, for proprietary designs and custom media mixes not meeting the media specifications contained in the City or County LID Manual, field scale testing data are provided to demonstrate that proposed media meets the pollutant treatment performance criteria in Section F.1 below."

    The MWS Linear has been tested under the Washington State TAPE protocol which is full scale field testing and has received General Use Level Designation under that protocol. Table F.1-1, as shown below, requires a biofiltration BMP to have Basic Treatment, Phosphorus Treatment, and Enhanced Treatment under this protocol. The MWS Linear has GULD approval for all three and therefore meets this minimum requirement 4. A copy of the TAPE approval has been attached to this document.

Table F.1-1: Required Technology Acceptance Protocol-Ecology Certifications for Polltuants of Concern for Biofiltration Performance Standard

Project Pollutant of Concern	Required Technology Acceptance Protocol-Ecology Certification for Biofiltration Performance Standard
Trash	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Sediments	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Oil and Grease	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Nutrients	Phosphorus Treatment[1]
Metals	Enhanced Treatment
Pesticides	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment
Organics	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment
Bacteria and Viruses	Basic Treatment (including bacteria removal processes)[3] , Phosphorus Treatment, Enhanced Treatment
Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment

5. Biofiltration BMPs must be designed to promote appropriate biological activity to support and maintain treatment processes.

    a. The MWS Linear an advanced vegetated biofiltration promotes biological processes found in both upland bioretention systems and wetlands. The system utilizes an advanced horizontal flow design to ensure maximum contact with the vegetation root mass. Bacterial growth, supported by the root system in the wetland chamber, performs a number of treatment processes. These vary as a function of moisture, temperature, pH, salinity, and pollutant concentrations. Biologically available forms of nitrogen, phosphorus, and carbon are actively taken into the cells of vegetation and bacteria, and used for metabolic processes (i.e., energy production and growth). Nitrogen and phosphorus are actively taken up as nutrients that are vital for a number of cell functions, growth, and energy production. These processes remove metabolites from the media during and between storm events, making the media available to capture more nutrients from subsequent storms.

    b. Soil organisms in the wetland chamber can break down a wide array of organic compounds into less toxic forms or completely break them down into carbon dioxide and water (Means and Hinchee 1994). Bacteria can also cause metals to precipitate out as salts, bind them within organic material, and accumulate metals in nodules within the cells. Finally, plant growth may metabolize many pollutants, sequester them or rendering them less toxic (Reeves and Baker 2000).

    c. Following are pictures from the plants pulled from a MWS Linear after only 14 months of growth. The media used in the system is designed to maximize biological activity:

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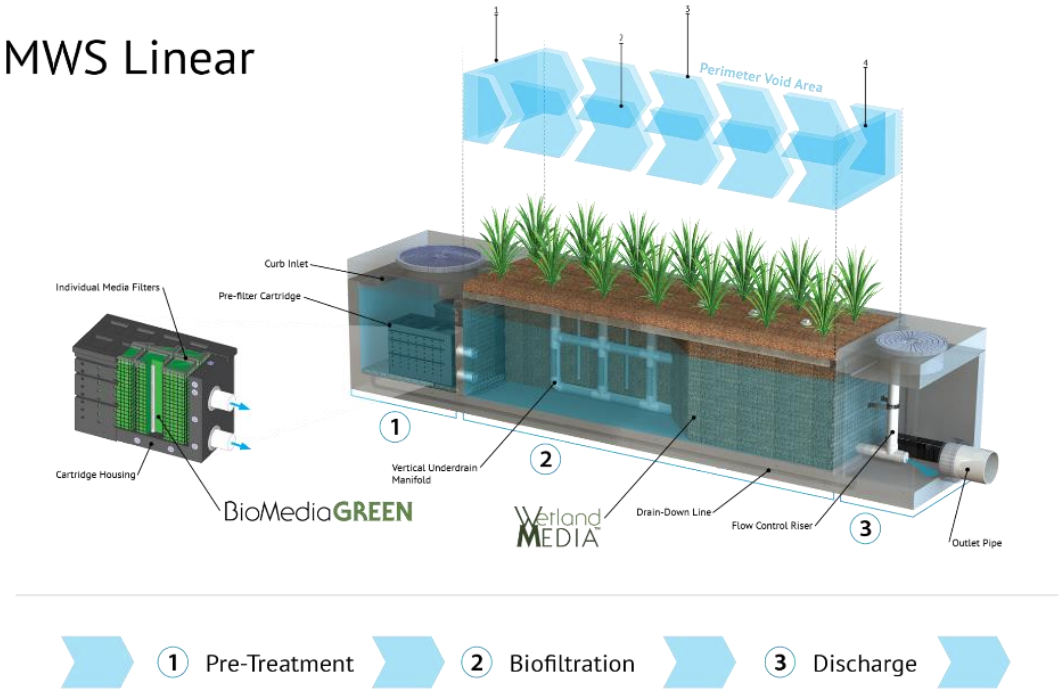
6. Biofiltration BMPs must be designed to prevent erosion, scour, and channeling within the BMP.

    a. The MWS Linear is a self-contained system with a pre-treatment chamber. Unlike other biofiltration BMPs erosion, scour, and channeling with in the BMP is not an issue. Following is a diagram of the BMP. The system pre-treatment chamber prevent any erosion or scour. The system downstream orifice control prevents channeling of the media:



7. Biofiltration BMP must include operations and maintenance design features and planning considerations to provide for continued effectiveness of pollutant and flow control functions.

    a. The MWS Linear provides activation along with the first year of maintenance and inspection free on all installation in the county of San Diego. Unlike other biofiltration BMPs the City and Co-permitees can be assured the system is being properly installed and maintained. The first year of inspections is used to gauge the amount of loading in the system and this information is used to set appropriate maintenance interval for subsequent years. Attached is a copy of the maintenance manual for the MWS Linear.

Designed & Maintained Consistent with their Performance Certifications

We are in agreement that all BMPs should be designed in a manner consistent with the TAPE certification. The MWS Linear is sized in accordance with the TAPE GULD approval which provides certification at a loading rate of 1 gpm/sq ft (100 in/hr) for Basic, Phosphorus and Enhanced treatment. In addition, as stated previously, Modular Wetland System, Inc. provide activation of all system installed in San Diego County along with the first year of inspections and maintenance to ensure appropriate function. As previously stated, a copy of the TAPE GULD approval is attached to support this claim.

Additionally, it should be noted that the manual allows for biofiltration BMPs to be sized in either volume based (DCV) or flow based design. The manual states in section F.2.2 Sizing of Flow-Based Biofiltration *BMPs:*

> *"This sizing method is only available when the BMP meets the pollutant treatment performance standard in Appendix F.1."*
>
> *"Proprietary biofiltration BMPs are typically designed as a flow-based BMPs (i.e., a constant treatment capacity with negligible storage volume). Additionally, proprietary biofiltration is only acceptable if no infiltration is feasible and where site-specific documentation demonstrates that the use of larger footprint biofiltration BMPs would be infeasible. The applicable sizing method for biofiltration is therefore reduced to: Treat 1.5 times the DCV."*
>
> *"The following steps should be followed to demonstrate that the system is sized to treat 1.5 times the DCV."*
>
> > *1. Calculate the flow rate required to meet the pollutant treatment performance standard without scaling for the 1.5 factor. Options include either:*
> >
> > - *Calculate the runoff flow rate from a 0.2 inch per hour uniform intensity precipitation event (See methodology Appendix B.6.3), or*
> >
> > - *Conduct a continuous simulation analysis to compute the size required to capture and treat 80 percent of average annual runoff; for small catchments, 5-minute precipitation data should be used to account for short time of concentration. Nearest rain gage with 5-minute precipitation data is allowed for this analysis.*

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2. Multiply the flow rate from Step 1 by 1.5 to compute the design flow rate for the biofiltration system.

3. Based on the conditions of certification/verification (discussed above), establish the design capacity, as a flow rate, of a given sized unit.

4. Demonstrates that an appropriate unit size and number of units is provided to provide a flow rate that meets the required flow rate from Step 2.

In conclusion, we have closely followed the process and protocol for showing the MWS Linear meets all the criteria to be accepted as Biofiltration as found in Appendix F.

If you have any questions please feel free to contact us directly.

Sincerely,

Zachariha J. Kent

Director of Engineering

Bio Clean Environmental Services, Inc.

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves monitoring for the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic

loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

- Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

- Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
- Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
- Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.

- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system’s influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

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Oceanside, CA 92054
gkent@biocleanenvironmental.net

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment

TAPE PERFORMANCE SUMMARY

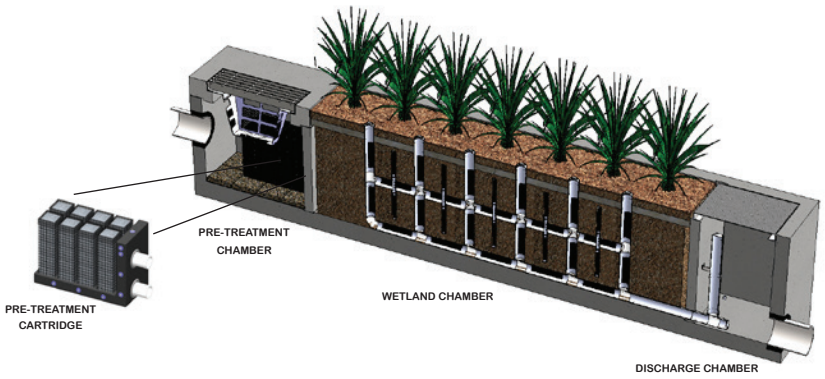
MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



TAPE PERFORMANCE

Modular Wetland System Linear 2.0 (MWS-L 2.0) completed its TAPE field testing in the spring of 2013. The Washington DOE has approved the system under the TAPE protocol. The MWS-Linear has met the performance benchmarks for the three major pollutant categories as defined by TAPE: Basic Treatment (TSS), Phosphorus and Enhanced (dissolved zinc and copper). It is the first system tested under the protocol to meet the benchmarks for all three categories.

Pollutant	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Total Suspended Solids	75.0	15.7	85%	Summary of all data meeting TAPE parameters pertaining to this pollutant. Mean of 8 microns.
Total Phosphorus	0.227	0.074	64%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Ortho Phosphorus	0.093	0.031	67%	Summary of all data meeting TAPE parameters for total phosphorus.
Nitrogen	1.40	0.77	45%	Utilizing the Kjeldahl method (Total Kjeldahl nitrogen). Summary of all data during testing.
Dissolved Zinc	0.062	0.024	66%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Dissolved Copper	0.0086	0.0059	38%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Total Zinc	0.120	0.038	69%	Summary of all data during testing.
Total Copper	0.017	0.009	50%	Summary of all data during testing.
Motor Oil	24.157	1.133	95%	Summary of all data during testing.

NOTES:
1. The MWS-Linear was proven effective at infiltration rates of up to 121 in/hr.
2. A minimum of 10 aliquots were collected for each event.
3. Sampling was targeted to capture at least 75 percent of the hydrograph.

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PERFORMANCE SUMMARY

MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

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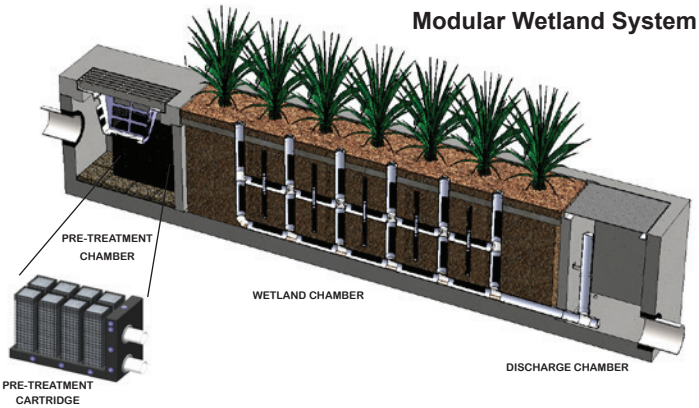
MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



Modular Wetland System Linear 2.0 (MWS-L 2.0) has been independently tested in laboratory and field conditions since 2008.

Oceanside Test Site

Portland Test Site

HEAVY METALS: Copper / Zinc

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	.76 / .95	.06 / .19	92% / 80%	Majority Dissolved Fraction
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.04 / .24	< .02 / < .05	>50% / >79%	Effluent Concentrations Below Detectable Limits
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	.058 / .425	.032 / .061	44% / 86%	Test Unit 2
TAPE Field Testing / Portland, OR 2011/2012	Field	.017/ .120	.009 / .038	50% / 69%	Total Metals

TOTAL SUSPENDED SOLIDS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	270	3	99%	Sil-co-sil 106 - 20 micron mean particle size
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	45.67	8.24	82%	Mean Particle Size by Count < 8 Microns
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	676	39	94%	Test Unit 2
TAPE Field Testing / Portland, OR 2011/2012	Field	75.0	15.7	85%	Means particle size of 8 microns

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PERFORMANCE SUMMARY

MWS-LINEAR 2.0

PHOSPHORUS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
TAPE Field Testing / Portland, OR 2011/2012	Field	.227	.074	64%	TOTAL P
TAPE Field Testing / Portland, OR 2011/2012	Field	.093	.031	67%	ORTHO P

BACTERIA:

Description	Type	Avg. Influent (MPN)	Avg. Effluent (MPN)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	1600 / 1600	535 / 637	67% / 60%	Fecal / E. Coli
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	31666 / 6280	8667 / 1058	73% / 83%	Fecal / E. Coli

LEAD:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	.54	.10	82%	Total
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	.01 / .043	.004 / .014	60% / 68%	Both Test Units
TAPE Field Testing / Portland, OR 2011/2012	Field	.011	.003	70%	Total

NITROGEN:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.85	.21	75%	NITRATE
TAPE Field Testing / Portland, OR 2011/2012	Field	1.40	0.77	45%	TKN

HYDROCARBONS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	10	1.625	84%	Oils & Grease
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.83	0	100%	TPH Motor Oil
TAPE Field Testing / Portland, OR 2011/2012	Field	24.157	1.133	95%	Motor Oil

TURBIDITY:

Description	Type	Avg. Influent (NTU)	Avg. Effluent (NTU)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	21	1.575	93%	Field Measurement
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	21	6	71%	Field Measurement

COD:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	516 / 1450	90 / 356	83% / 75%	Both Test Units

All removal efficiencies and concentrations rounded up for easy viewing. Please call us for more information, including full copies of the reports reference above.

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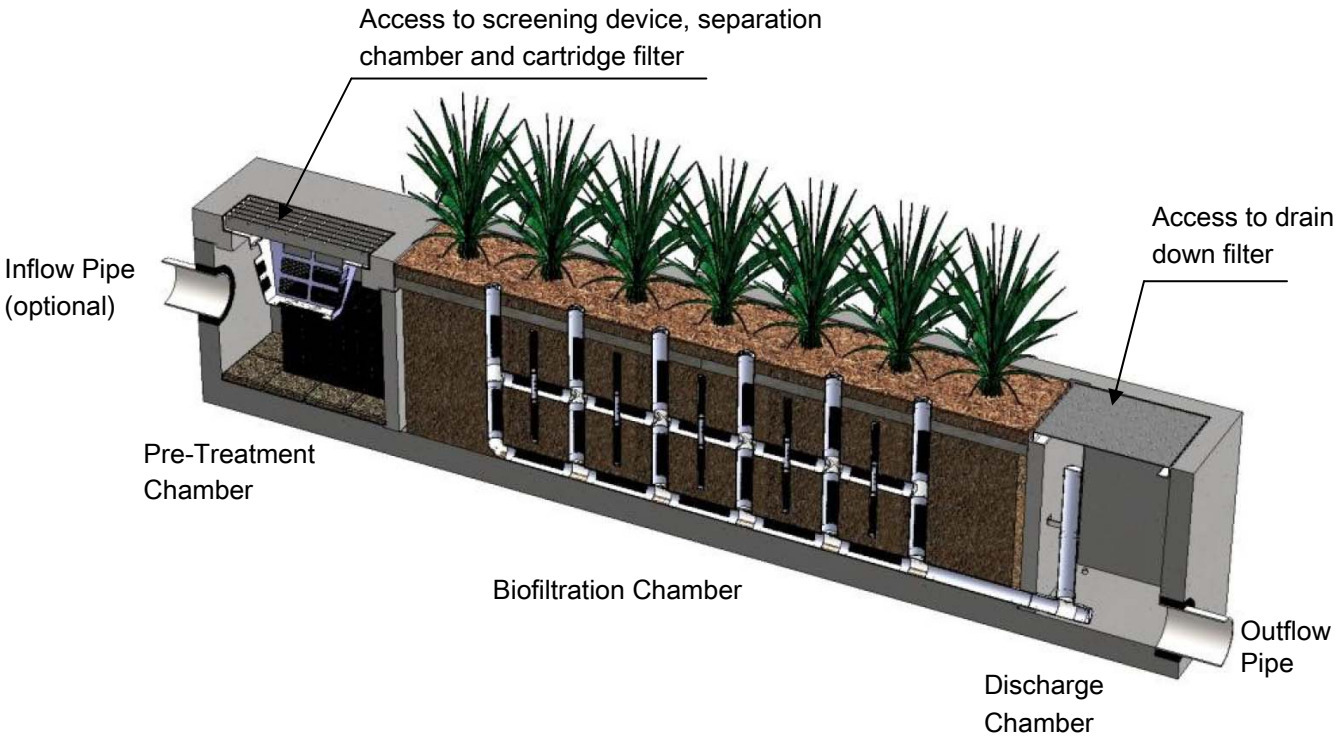
Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

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Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes:

2972 San Luis Rey Road, Oceanside, CA 92058 P (760) 433-7640 F (760) 433-3176

Maintenance Report

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

ATTACHMENT 2
BACKUP FOR PDP HYDROMODIFICATION CONTROL MEASURES

This is the cover sheet for Attachment 2.

☒ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

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Project Name: Imperial Beach Resort

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	☐ Included See Hydromodification Management Exhibit Checklist.
Attachment 2b	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☐ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map (Required) Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2c	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☐NotPerformed ☐Included ☐Sumitted as separarte stand-alone document
Attachment 2d	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	☐Included ☐Submitted as separate stand-alone document
Attachment 2e	Vector Control Plan (Required when structural BMPs will not drain in 96 hours)	☐Included ☐Not required because BMPs will drain in less than 96 hours

Project Name: Imperial Beach Resort

Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

The Hydromodification Management Exhibit must identify:

☐ Underlying hydrologic soil group
☐ Approximate depth to groundwater
☐ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
☐ Critical coarse sediment yield areas to be protected
☐ Existing topography
☐ Existing and proposed site drainage network and connections to drainage offsite
☐ Proposed grading
☐ Proposed impervious features
☐ Proposed design features and surface treatments used to minimize imperviousness
☐ Point(s) of Compliance (POC) for Hydromodification Management
☐ Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
☐ Structural BMPs for hydromodification management (identify location, type of BMP, and size/detail)


Evergreen Ave
Elder Ave
Seacoast Dr
Ocean Ln
2nd St
Ebony Ave
1060 Seacoast Dr
Imperial Beach Blvd
SITE BOUNDARY
CCSY AREAS


SITE
PACIFIC OCEAN
EXEMPT SYSTEM
Ebony Ave
Ebony Ave
Seacoast Dr
Seacoast Dr
IB Forum Sports
Bar & Grill
Imperial Beach Blvd
Imperial Beach Blvd

ATTACHMENT 3
STRUCTURAL BMP MAINTENANCE INFORMATION

This is the cover sheet for Attachment 3.

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Project Name: Imperial Beach Resort

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 3a	Structural BMP Maintenance Thresholds and Actions (Required)	☐ Included See Structural BMP Maintenance Information Checklist.
Attachment 3b	Maintenance Agreement (Form DS-3247) (when applicable)	☐Included ☐Not Applicable

Project Name: Imperial Beach Resort

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Preliminary Design / Planning / CEQA level submittal:

- Attachment 3a must identify:
  - ☐ Typical maintenance indicators and actions for proposed structural BMP(s) based on Section 7.7 of the BMP Design Manual
- Attachment 3b is not required for preliminary design / planning / CEQA level submittal.

Final Design level submittal:

Attachment 3a must identify:

- ☐ Specific maintenance indicators and actions for proposed structural BMP(s). This shall be based on Section 7.7 of the BMP Design Manual and enhanced to reflect actual proposed components of the structural BMP(s)
- ☐ How to access the structural BMP(s) to inspect and perform maintenance
- ☐ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- ☐ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- ☐ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- ☐ When applicable, frequency of bioretention soil media replacement
- ☐ Recommended equipment to perform maintenance
- ☐ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management

Attachment 3b: For private entity operation and maintenance, Attachment 3b must include a Storm Water Management and Discharge Control Maintenance Agreement (Form DS-3247). The following information must be included in the exhibits attached to the maintenance agreement:

- ☐ Vicinity map
- ☐ Site design BMPs for which DCV reduction is claimed for meeting the pollutant control obligations.
- ☐ BMP and HMP location and dimensions
- ☐ BMP and HMP specifications/cross section/model
- ☐ Maintenance recommendations and frequency
- ☐ LID features such as (permeable paver and LS location, dim, SF).

MAINTENANCE

MWS – Linear

Hybrid Stormwater Filtration System

Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

MAINTENANCE

Maintenance Summary –

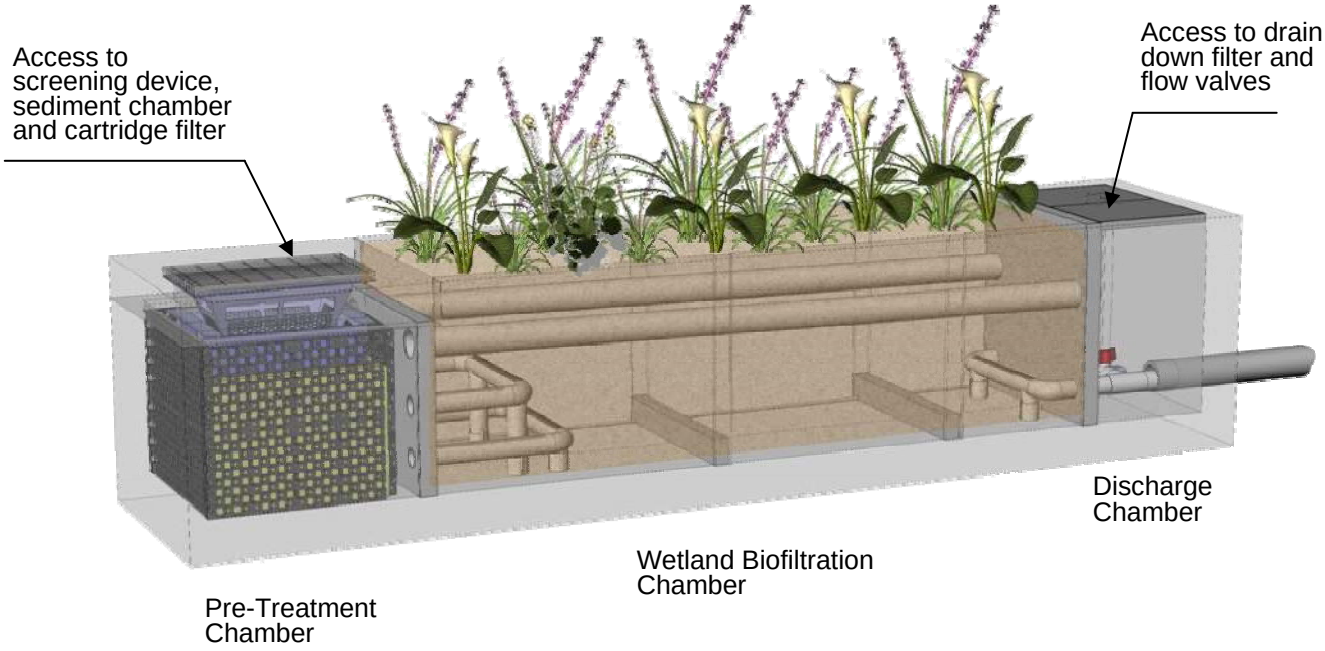
- **<u>Clean Bio Clean® Catch Basin Filter</u> – average maintenance interval is 3 to 6 months.**
  - **(*15 minute service time*).**
- **<u>Clean Separation (sediment) Chamber</u> – average maintenance interval is 6 to 18 months.**
  - **(*30 minute service time*).**
- **<u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – average maintenance interval 6 – 12 months.**
  - **(*45 minute service time*).**
- **<u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – average maintenance interval is 6 to 12 months.**
  - **(*5 minute service time*).**
- **<u>Trim Vegetations</u> – average maintenance interval is 3 to 6 months.**
  - **(*15 minute service time*).**
- **<u>Evaluate Wetland Media Flow Hydraulic Conductivity</u> – average inspection interval is once per year.**
  - ***(5 minute inspection time).***
- **<u>Wetland Media Replacement</u> – average maintenance interval is 5 to 20 years.**
  - **(*6 hours*).**

For more information on maintenance procedures, to order replacement media or find an authorized service company please contact:

Modular Wetland Systems, Inc
2972 San Luis Rey Road
Oceanside, CA 92058

Phone: 760-433-7640
Fax: 760-433-3176
Email: info@modularwetlands.com

System Diagram –



Maintenance Overview –

A. Every installed MWS – Linear unit is to be maintained by the Supplier, or a Supplier approved contractor. The cost of this service varies among providers.

B. The MWS – Linear is a multi-stage self-contained treatment train for stormwater treatment. Each stage protects subsequent stages from clogging. Stages include: screening, separation, cartridge media filtration, and biofiltration. The biofiltration stage contains various types of vegetation which will require annual evaluation and trimming.

1. <u>Clean Bio Clean® Catch Basin Filter</u> – Screening is provided by well proven catch basin filter. The filter has a trash and sediment capacity of 2 (curb type) and 4 (grate type) cubic feet. The filter removes gross solids, including litter, and sediments greater than 200 microns. This procedure is easily done by hand or with a small industrial vacuum device. This filter is located directly under the manhole or grate access cover.

2. <u>Clean Separation (sediment) Chamber</u> – separation occurs in the pre-treatment chamber located directly under the curb or grated inlet. This chamber has a capacity of approximately 21 cubic feet for trash, debris and sediments. This chamber targets TSS, and particulate metals and nutrients. This procedure can be performed with a standard vacuum truck. This chamber is located directly under the manhole or grate access cover.

3. <u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – Primary filtration is provided by a horizontal flow cartridge filter utilizing BioMediaGREEN blocks. Each cartridge has a media surface area of 35 square feet. The large surface area will insure long term operation without clogging. The cartridge filter with BioMediaGREEN targets fine TSS, metals, nutrients, hydrocarbons, turbidity and bacteria. Media life depends on local loading conditions and can easily be replaced and disposed of without any equipment. The filters are located in the pre-treatment chamber. Entry into chamber required to replace BioMediaGREEN blocks. Each cartridge contain 14 pieces of 20" tall BioMediaGREEN.

4. <u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – A drain down filter, similar in function to the perimeter filter is located in the discharge chamber. This filter allows standing water to be drained and filtered out of the separation chamber. This addresses any vector issues, by eliminating all standing water within this system. Replacement of media takes approximately 5 minutes and is performed without any equipment.

5. <u>Trim Vegetations</u> – The system utilizes multiple plants in the biofiltration chamber to provide enhanced treatment for dissolved pollutants including nutrients and metals. The vegetation will need to be maintained (trimmed) as needed. This can be done as part of the project normal landscape maintenance. **NO FERTILIZER SHALL BE USED IN THIS CHAMBER.**

<u>6. Evaluate Wetland Media Flow Hydraulic Conductivity</u> – The systems flow can be assessed from the discharge chamber. This should be done during a rain event. By viewing into the discharge chamber the flow out of the system can be observed. If little to know flow is observed from the lower valve or orifice plate this is a sign of potential wetland media (biofiltration) maintenance needs.

<u>7. Wetland Media Replacement</u> – biofiltration is provided by an advance horizontal flow vegetated wetland. This natural filter contains a mix of sorptive media that supports abundant plant life. This biofilter targets the finest TSS, dissolved nutrients, dissolved metals, organics, pesticides, oxygen demanding substances and bacteria. This filter provides the final polishing step of treatment. If prior treatment stages are properly maintained, the life of this media can be up to 20 years. Replacement of the media is simple. Removal of spent media can be done with a shovel of a vacuum truck.

C. The MWS – Linear catch basin filter, separation chamber, cartridge filter media and wetland media are designed to allow for the use of vacuum removal of captured pollutants and spent filter media by centrifugal compressor vacuum units without causing damage to the filter or during normal cleaning and maintenance. Filter and chambers can be cleaned from finish surface through standard manhole or grate access.

Maintenance Procedures –

1. <u>Clean Bio Clean® Catch Basin Filter</u> – Modular Wetland Systems, Inc. recommends the **catch basin filter** be inspected and cleaned a minimum of once every six months and replacement of hydrocarbon booms once a year. The procedure is easily done with the use of any standard vacuum truck. *This procedure takes approximately 15 minutes.*

1. Remove grate or manhole to gain access to catch basin filter insert. Remove the deflector shield (grate type only) with the hydrocarbon boom attached. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
2. Remove all trash, debris, organics, and sediments collected by the inlet filter insert. Removal of the trash and debris can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screen of the filter.
3. Evaluation of the hydrocarbon boom shall be performed at each cleaning. If the boom is filled with hydrocarbons and oils it should be replaced. Attach new boom to basket with plastic ties through pre-drilled holes in basket. Place the deflector shield (grate type only) back into the filter.
4. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
5. The hydrocarbon boom may be classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

2. <u>Clean Separation (sediment) Chamber</u> – Modular Wetland Systems, Inc. recommends the **separation chamber** be inspected and cleaned a minimum of once a year. The procedure is easily done with the use of any standard vacuum truck. *This procedure takes approximately 30 minutes.*

1. Remove grate or manhole to gain access to the catch basin filter.
2. Remove catch basin filter. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
3. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
4. Vacuum out separation chamber and remove all accumulated debris and sediments.
5. Replace catch basin filter, replace grate or manhole cover.
6. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

3. <u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – Modular Wetland Systems, Inc. recommends the **cartridge filters** media be inspected and cleaned a minimum of once a year. The procedure will require prior maintenance of separation chamber. *Replacement of media takes approximately 45 minutes.*

1. Remove grate or manhole to gain access to the catch basin filter.
2. Remove catch basin filter. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
3. Enter separation chamber.
4. Unscrew the two ½" diameter bolts holding the lid on each cartridge filter and remove lid and place outside of unit.
5. Remove each of the 14 BioMediaGREEN filter blocks in each cartridge and remove from chamber for disposal.
6. Spray down the outside and inside of the cartridge filter to remove any accumulated sediments.
7. Replace with new BioMediaGREEN filter blocks insuring the blocks are properly lined up and seated in the bottom.
8. Replace the lid and tighten down bolts.
9. Replace catch basin filter, replace grate or manhole cover.
10. Transport all debris, trash, organics, spent media and sediments to approved facility for disposal in accordance with local and state requirements.

4. <u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – Modular Wetland Systems, Inc. recommends the **drain down filter** be inspected and maintained a minimum of once a year. *Replacement of media takes approximately 5 minutes.*

1. Open hatch of discharge chamber
2. Enter chamber, unlatch drain down filter cover.
3. Remove BioMediaGREEN filter block
4. Replace with new block, replace and latch cover.
5. Exit chamber, close and lock down the hatch.
6. Transport spent media to approved facility for disposal in accordance with local and state requirements.

5. <u>Trim Vegetations</u> – Modular Wetland Systems, Inc. recommends the plants/vegetation be inspected and maintained a minimum of once a year. It is also recommended that the plants receive the same care as other landscaped areas. **Note: No fertilizer is to be used on this area.** *Trimming of vegetation takes approximately 15 minutes.*

<u>6. Evaluate Wetland Media Flow Hydraulic Conductivity</u> – Modular Wetland Systems, Inc. recommends system flow be inspected and observed a minimum of once a year. This needs to be done during a rain event. *Inspection and Observation takes approximately 5 minutes.*

1. Open hatch of discharge chamber
2. Observe the level of flow from the bottom valve or orifice plate.
3. If flow is steady and high the system is operating normally.

4. If little or no flow is observed exiting the valve possible maintenance to the biofiltration wetland chamber may be needed. Contact Modular Wetlands for further assistance.
5. Exit chamber, close and lock down the hatch.

7. Wetland Media Replacement – Modular Wetland Systems, Inc. recommends the wetland media be replaced a minimum of one every 20 years. *Inspection takes approximately 15 minutes. Replacement of rock media takes approximately 6 hours and requires a vacuum truck.*

1. Remove plants from the wetland chamber.
2. Use a vacuum truck or shovel to remove all wetland media.
3. Spray down the walls and floor of the chamber and vacuum out any accumulated pollutants.
4. Spray down perforated piping and netting of flow matrix and the inflow and outflow end to remove any accumulated pollutants.
5. Vacuum out any standing water from the media removal and insure the chamber is cleaning.
6. Use a small backhoe to fill chamber with new media. Call Modular Wetland Systems, Inc. for media delivery information.
7. Install BioMediaGREEN filter blocks across over the entire filter bed. Fill with media until 9” from top. The install filter blocks which are 3” thick. Fill the top 6” inches with wetland media.
8. Plant new vegetation in the same configuration and quantity as old vegetation. Dig down until the BioMediaGREEN is exposed. Cut out a small circle of the BioMediaGREEN. Remove plant from container including soil ball and place in the whole cut out of the BioMediaGREEN. Cover up with wetland media.
9. Spray down the plants and media with water to saturate.
10. Continue supplemental irrigation (spray or drip) for at lest 90 days.

7. Other Maintenance Notes –

1. Following maintenance and/or inspection, the maintenance operator shall prepare a maintenance/inspection record. The record shall include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanism. .
2. The owner shall retain the maintenance/inspection record for a minimum of five years from the date of maintenance. These records shall be made available to the governing municipality for inspection upon request at any time.
3. Any person performing maintenance activities must have completed a minimum of OSHA 24-hour hazardous waste worker (hazwoper) training.
4. Remove access manhole lid or grate to gain access to filter screens and sediment chambers. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
5. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
6. The hydrocarbon boom is classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

Maintenance Sequence –

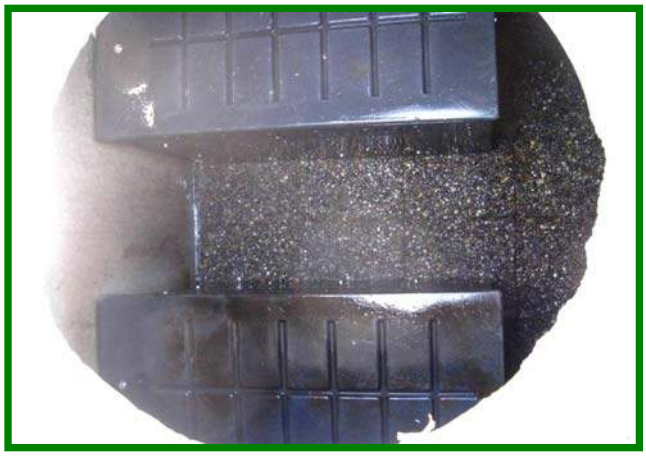
Access Pre-Treatment Chamber by Removing Manhole or Grate Cover

Assess Pollutant Loading in Catch Basin Filter and Sediment Chamber

Vacuum Catch Basin Filter

Remove Catch Basin Filter

Vacuum out the Sediment Chamber



Enter Chamber Remove Lids of Cartridge Filters

Remove Spent BioMediaGREEN Filter Blocks

Spray Down and Clean Cartridge Filter Housing

Replace with New BioMediaGREEN Filter Blocks and Replace Lid, then Catch Basin Filter and Replace Manhole or Grate

Open Discharge Chamber Lid to Asses Wetland Media Flow Rate and Replace Drain Down Filter Near Bottom

Evaluate Vegetation and Trim if Needed. Maintenance Complete.

Please Contact Modular Wetland Systems, Inc. for More Information:

760-433-7640

info@modularwetlands.com

Stormwater Management Fact Sheet: Bioretention

Description

Bioretention areas are landscaping features adapted to treat stormwater runoff on the development site. They are commonly located in parking lot islands or within small pockets in residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix. Typically, the filtered runoff is collected in a perforated underdrain and returned to the storm drain system. For more information see *Bioretention as a Water Quality Best Management Practice*, Article 110 in the Practice of Watershed Protection.

Applicability

Bioretention systems are generally applied to small sites, but can be applied to a wide range of development. Bioretention can be applied in many climate and geologic situations, with some minor design modifications.

Regional Applicability
Bioretention systems are applicable almost everywhere in the United States. In arid or cold climates, however, some minor design modifications may be needed.

Ultra Urban Areas
Ultra urban areas are densely developed urban areas in which little pervious surface exists. Bioretention facilities are ideally suited to many ultra urban areas, such as parking lots. While they consume a fairly large amount of space (approximately 5% of the area that drains to them), they can fit into existing parking lot islands or other landscaped areas.

Stormwater Hotspots
Stormwater hotspots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater. A typical example is a gas station or convenience store parking lot. Bioretention areas can be used to treat stormwater hotspots as long as an impermeable liner is used at the bottom of the filter bed.

Stormwater Retrofit
A stormwater retrofit is a stormwater management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other objectives. Bioretention can be used as a stormwater retrofit, by modifying existing landscaped areas, or if a parking lot is being resurfaced. In highly urban watersheds, they are one of the few retrofit options that can be employed. However, it is very expensive to retrofit an entire watershed using bioretention areas since they treat small sites.

Cold Water (Trout) Streams
The species in cold water streams, notably trout, are extremely sensitive to changes in temperature. In order to protect these resources, designers should avoid treatment practices that increase the temperature of the stormwater runoff they treat. Bioretention is a good option in cold water streams because water ponds in them for only a short time, decreasing the potential for stream warming.

Siting and Design Considerations

Designers need to consider conditions at the site level and must incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

Siting
Some considerations selecting a stormwater treatment practice are the drainage area the practice will need to treat, the slopes both at the location of the practice and draining to it, soil and subsurface conditions, and the depth of the seasonably high groundwater table. Bioretention can be applied on many sites, with its primary restriction being the need to apply the practice on small sites.

Drainage Area

Bioretention areas should usually be used on small sites (i.e., five acres or less). When used to treat larger areas, they tend to clog. In addition, it is difficult to convey flow from a large area to a bioretention area.

Slope

Bioretention areas are best applied to relatively shallow slopes (usually about 5%). Sufficient slope is needed at the site to ensure that the runoff that enters a bioretention area can be connected with the storm drain system. It is important to note, however, that these bioretention areas are most often applied to parking lots or residential landscaped areas, which generally have gentle slopes.

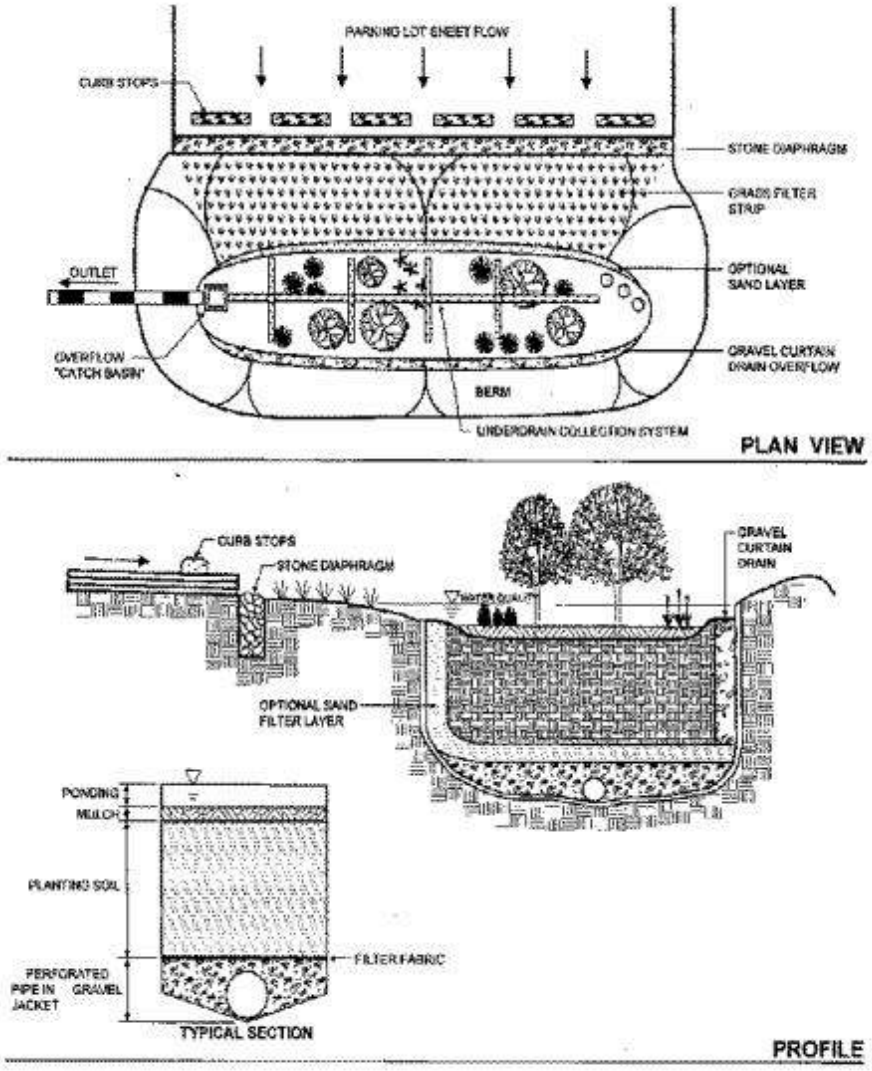
Soils /Topography

Bioretention areas can be applied in almost any soils or topography, since runoff percolates through a made soil bed, and is returned to the stormwater system.

Groundwater

Bioretention should be separated from the watertable to ensure that the groundwater never intersects with the bottom of the bioretention area, which prevents possible groundwater contamination and practice failure.

Design Considerations
Specific designs may vary considerably, depending on site constraints or preferences of the designer or community, but some features, should be incorporated into all bioretention areas. These design features can be divided into five basic categories: *pretreatment, treatment*, *conveyance*, *maintenance reduction*, and *landscaping (*for more information see the Manual Builder Category) (see Figure 1).



Pretreatment

Pretreatment refers to features of a bioretention area that capture and remove coarse sediment particles. Incorporating pretreatment helps to reduce the maintenance burden of bioretention, and reduces the likelihood that the soil bed will clog over time. Several different mechanisms are used to provide pretreatment in bioretention areas. Runoff can be directed to a grass channel or filter strip to settle out coarse sediments before the runoff flows into the filter bed of the bioretention area. Other features may include a pea gravel diaphragm, which acts to spread flow evenly and drop out larger particles.

Treatment

Treatment features enhance the ability of a stormwater treatment practice to remove pollutants. Several basic features should be incorporated into bioretention areas to enhance their pollutant removal rates. The bioretention system should be sized be between 5% and 10% of the impervious area draining to it. The practice should be designed with a soil bed that is a sand/ soil matrix with a mulch layer above the soil bed. The bioretention area should be designed to pond a small depth of water (6" to 9") above the filter bed.

Conveyance

Conveyance of stormwater runoff into and through a stormwater practice is a critical component of any stormwater treatment practice. Stormwater should be conveyed to and from the practice safely and minimize erosion potential.

Bioretention areas are designed with an underdrain system to collect filtered runoff at the bottom of the filter bed and direct it to the storm drain system. An underdrain is a perforated pipe in a gravel bed, installed along the bottom of filter bed. Stormwater management practices, and used to collect and remove filtered runoff. Designers should also provide an overflow structure to convey flow from large storms (that are not treated by the bioretention area) to the storm drain system.

Maintenance Reduction

In addition to regular maintenance, bioretention areas should incorporate design features to reduce the long term maintenance of a bioretention area. Designers should ensure that the bioretention area is easily accessible for maintenance.

Landscaping

Landscaping is critical to the function and appearance of bioretention areas. It is preferred that native vegetation is used for landscaping, where possible. Plants should be selected that can withstand the hydrologic regime they will experience (i.e., plants that tolerate both wet and dry conditions). At the edges, which will remain primarily dry, upland species will be the most resilient. Finally, it is best to select a combination of trees, shrubs, and herbaceous materials.

Design Variations

One design alternative to bioretention areas is the use of a "partial exfiltration" system, which promotes greater groundwater recharge (see below).

Partial Exfiltration

In this design variation, the underdrain of a bioretention area only is only installed on part of the bottom of the system. This design allows for greater infiltration of stormwater runoff, with the underdrain acting as more of an overflow. This system can be applied only when the soils and other characteristics are appropriate for infiltration (for more information see the Infiltration Trench and Infiltration Basin Fact Sheet in the Fact Sheet Category).

Arid Climates

In arid climates, bioretention areas should be landscaped with drought tolerant plant species.

Cold Climates

In cold climates, bioretention areas can be used as a snow storage area. When used for this purpose, or if used to treat parking lot runoff, the bioretention area should be planted with salt tolerant, and non-woody plant species.

Limitations

Bioretention areas have a few limitations. Bioretention areas cannot be used to treat large drainage areas, limiting their usefulness for some sites. Although bioretention areas do not consume a large amount of space, incorporating bioretention into a parking lot design may reduce the number of parking spaces available. Finally, the construction cost of bioretention areas relatively high compared with other stormwater treatment practices. (See *Cost Considerations* for a more detailed explanation).

Maintenance Considerations

Bioretention requires seasonal landscaping maintenance. In many cases, bioretention areas require intense maintenance initially to establish the plants, but less maintenance is required in the long term. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site.

Table 1. Typical Maintenance Activities for Bioretention Areas

Activity	Schedule
• Remulch void areas • Treat diseased trees and shrubs	As needed
• Water plants daily for two weeks	At project completion
• Inspect soil and repair eroded areas • Remove litter and debris	Monthly
• Remove and replace dead and diseased vegetation	Twice per year
• Add additional mulch • Replace tree stakes and wire	Once per year

Effectiveness

Structural stormwater management practices can be used to achieve four broad resource protection goals. These include: *Flood Control, Channel Protection, Groundwater Recharge,* and *Pollutant Removal*. In general, bioretention areas can only provide pollutant removal.

Groundwater Recharge
Bioretention areas do not usually recharge the groundwater, except in the case of the partial exfiltration design (see *Design Variations*).

Pollutant Removal
Little pollutant removal data has been collected on the pollutant removal effectiveness of bioretention areas. In fact only one study has been conducted (Davis *et al*., 1998). The data from this study is presented in Table 2.

Table 2. Typical Pollutant Removal Rates of Bioretention Systems

Pollutant	Pollutant Removal (%)
TSS	81
TP	29
TN	49
NOx	38
Metals	51-71
Bacteria	-58

Assuming that bioretention systems perform similarly to swales, their removal rates are relatively high (for more information, see *Comparative Pollutant Removal Capability of Stormwater Treatment Practices*, Article 64 in The Practice of Watershed Protection).

Cost Considerations

Bioretention areas are relatively expensive. The following cost equation was developed by Brown and Schueler (1997), adjusting for inflation:

$$C = 7.30\ V^{0.99}$$

Where:
C = Construction, Design and Permitting Cost ($)
V = Volume of water treated by the facility (cubic feet)
This amounts to about $6.80 per cubic foot of water storage.

An important consideration when evaluating the costs of bioretention is that it often replaces area that would likely be landscaped anyway. Thus, the true cost of the bioretention area may be less than the construction cost reported. Similarly, maintenance costs for bioretention areas are not very different from normal landscaping maintenance. Land consumed by bioretention areas is relatively high compared with other practices (about 5% of the drainage area). However, this land should not be considered lost, since it is often fits with existing setbacks and landscaping requirements.

References

Brown, W. and T. Schueler. 1997. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for: Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Center for Watershed Protection (CWP), Environmental Quality Resources and Loiederman Associates. 1998. Maryland Stormwater Design Manual. Prepared for: Maryland Department of the Environment. Baltimore, MD. http://www.mde.state.md.us/environment/wma/stormwatermanual/mdswmanual.html

Center for Watershed Protection (CWP). 1997. Stormwater BMP Design Supplement for Cold Climates. Prepared for: US EPA Office of Wetlands, Oceans and Watersheds. Washington, DC.

Center for Watershed Protection (CWP). 1996. Design of Stormwater Filtering Systems. Prepared for: Chesapeake Research Consortium. Solomons, MD. and US EPA Region V. Chicago, IL.

Davis, A., M. Shokouhian, H. Sharma, and C. Henderson. 1998. Optimization of Bioretention Design for Water Quality and Hydrologic Characteristics. Department of Civil Engineering, University of Maryland, College Park.

Engineering Technologies Associates and Biohabitats. 1993. Design Manual for Use of Bioretention in Stormwater Management. Prepared for: Prince George's County Government; Watershed Protection Branch. Landover, MD.

Prince George's County Department of Environmental Resources. 1997. Low Impact Development. Laurel, MD

ATTACHMENT 4
COPY OF PLAN SHEETS SHOWING PERMANENT STORM WATER BMPS

This is the cover sheet for Attachment 4.

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Project Name: Imperial Beach Resort

Use this checklist to ensure the required information has been included on the plans:

The plans must identify:

☒ Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
☒ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
☒ Details and specifications for construction of structural BMP(s)
☒ Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
☒ How to access the structural BMP(s) to inspect and perform maintenance
☒ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
☒ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
☒ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
☒ Recommended equipment to perform maintenance
☒ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
☒ Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
☒ All BMPs must be fully dimensioned on the plans
☒ When propritery BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

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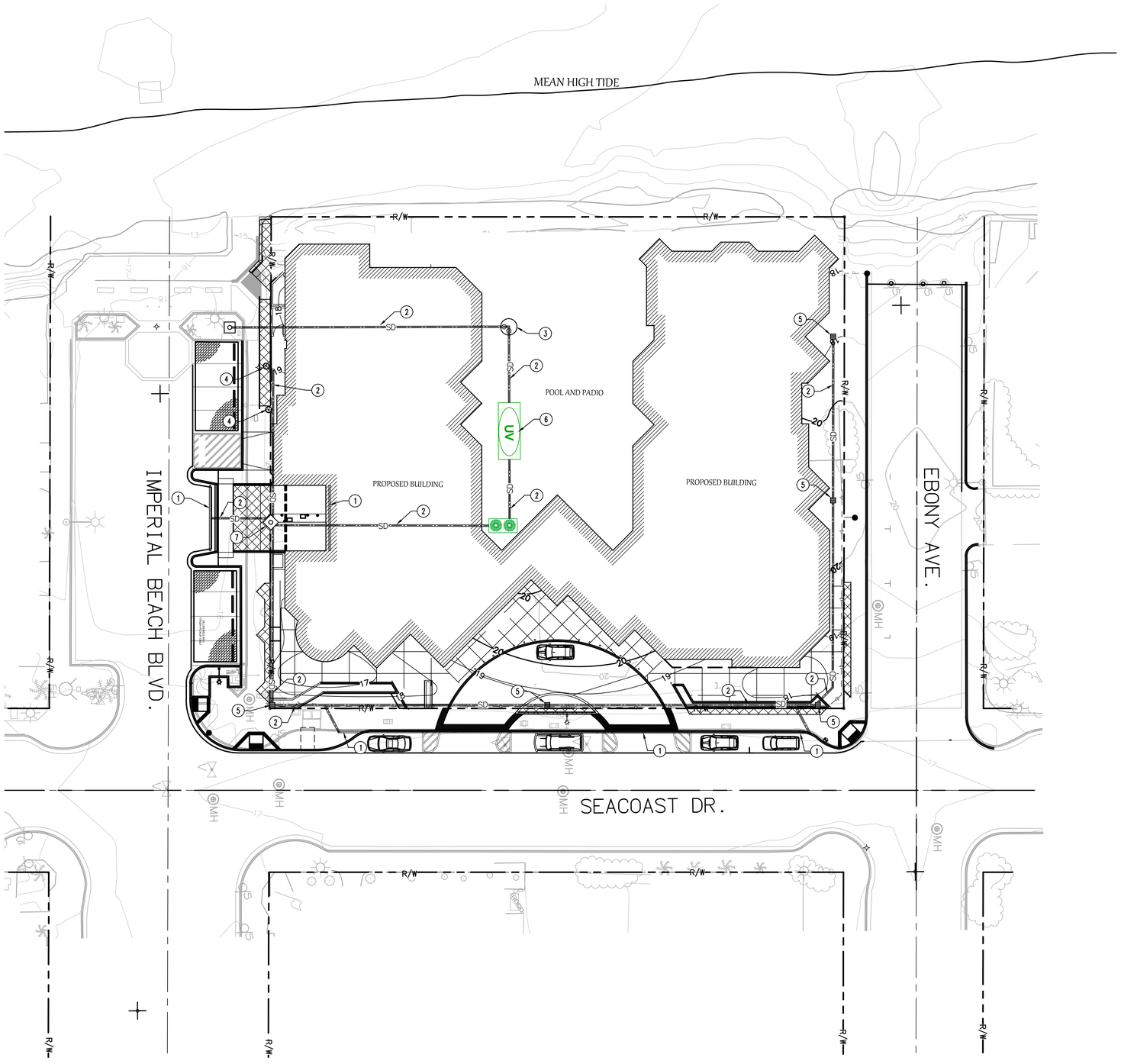

BMP LEGEND

- LIMITS OF OVERALL DRAINAGE BASIN
- BIORETENTION BASIN
- IMPERVIOUS AREA
- PERVIOUS AREA
- DRAINAGE BASIN
- FLOW PATH
- POINT COMPLIANCE
- STORM DRAIN INLET
- STORM DRAIN CLEANOUT
- ATRIUM DRAIN
- MODULAR WETLAND SYSTEM
- PUMP STATION
- UNDERGROUND VAULT (UV)
- PROPOSED STORM DRAIN (SD)
- PROPOSED TRENCH DRAIN

1. PROPOSED TRENCH DRAIN
2. PROPOSED STORM DRAIN
3. PROPOSED PUMP STATION
4. PROPOSED ATRIUM DRAIN
5. PROPOSED 12" X 12" CATCH BASIN,
6. PROPOSED UNDERGROUND VAULT
7. PROPOSED STORM DRAIN CLEANOUT (SDCO)

DMA SUMMARY		
DMA ID	AREA	TYPE
DMA-1	37,897 SF	MODULAR WETLAND

SCALE: 1"=20'

20 0 20 40 60
SCALE: 1"=20'

IMPERIAL BEACH RESORT

1046 SEACOAST DR.
IMPERIAL BEACH, CA

BMP
PLOT PLAN

08 / 11 / 16

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ATTACHMENT 5
DRAINAGE REPORT

Attach project's drainage report. Refer to Drainage Design Manual to determine the reporting requirements.

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Hydrology and Hydraulic Study
For

Prepared For:
Imperial Beach Resort, LLC
10450 South Eastern Ave., Suite 100
Henderson, NV 89052
APN No. 625-380-27-00

Prepared By:
Michael Baker International
9755 Clairemont Mesa Blvd
San Diego, CA 92124
858.614.5000
Richard S. Tomlinson, Jr. PE,
QSP, QSD, CPSWQ

Job Number:
149346

Prepared:
December 14, 2015

Revised:
February 16, 2017

Michael Baker
INTERNATIONAL

Table of Contents

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Section 1 Project Description and Scope

1.1. Project Data

Project Owner: Imperial Beach Resort, LLC
10450 S. Eastern Ave., Suite #100
Henderson, NV 89052
Kenneth Knudsen

Project Site Address: 1060 Seacoast Dr., Imperial Beach, CA

APN Number(s): 625-380-27-00

Project Location: Latitude: 32.577025
Longitude: -117.132070

Project Site Area: 1.00 Acres

Adjacent Streets:

North:	Ebony Avenue
South:	Imperial Beach Boulevard
East:	Seacoast Drive
West:	None

Adjacent Land Uses:

North:	Residential
South:	Residential
East:	Residential/Commercial
West:	Public Beach

1.2. Scope of Report

This report addresses the Hydrologic and Hydraulic aspects of the project. This report does not discuss required water quality measures to be implemented on a permanent basis, nor does it address construction storm water issues. Post construction storm water issue discussions can be found under separate cover in the project "Storm Water Quality Management Plan".

1.3. Project Site Information

1.3.1 Project Location

The project is located in beautiful Imperial Beach, California. The project is located in the southwesterly portion of the City and is adjacent to the beach and Pacific Ocean. Please refer to Figure 1below for a Vicinity Map.

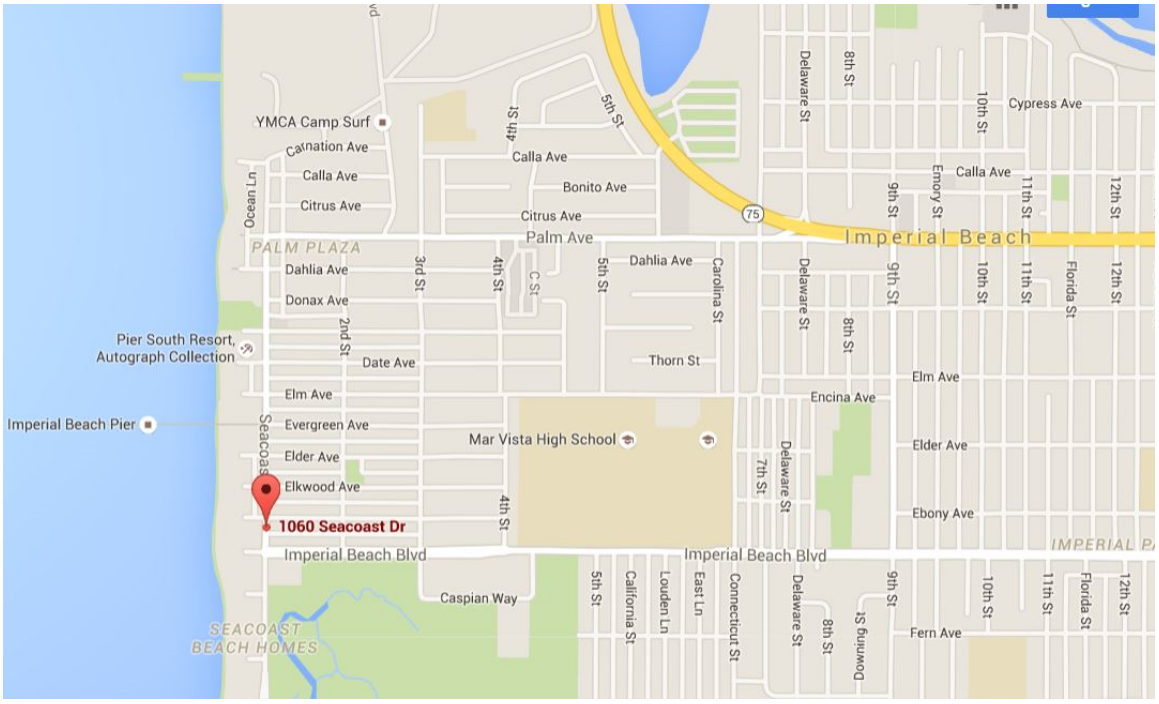

Figure 1: Vicinity Map

1.3.2 Project Description

The project proposes the construction of a 100 room hotel with underground parking. The project also proposes new underground utility services and access drives for the underground parking.

1.3.3 Site Topography

The project area is currently fully developed, and is home to multiple commercial buildings. Drainage from the site is broken down into 2 basins. Basin 1 encompasses the western half of the site, with runoff surface flowing southwest onto Imperial Beach Drive. Basin 2 encompasses the eastern half of the site with flows drainage towards Seacoast Drive. The site is flat with all slopes under 5%.

1.3.4 Land Use and Vegetation

The site has been partially graded for the preparation for the proposed project. There is no significant vegetation on site, and no native vegetation.

1.3.5 FEMA Information

The Federal Emergency Management Agency (FEMA) has mapped the floodplain site. The project does not lie within any mapped floodplain (FIRM Panel 0673C2134G). The project lies within Zone X Unshaded which is outside the 500-year floodplain.

a) Flood Zone Definitions

Zone A -- Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Zone AE -- Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Zone X (Shaded) – Areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.

Zone X (Unshaded) Areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood.

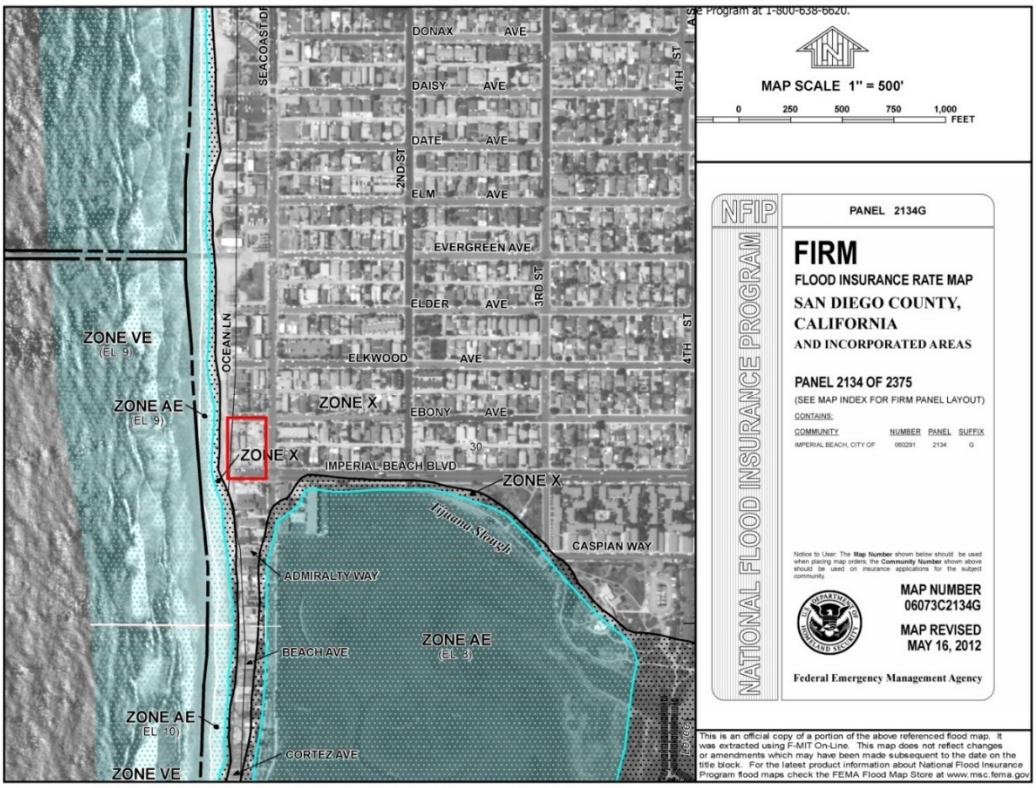

Figure 2: FEMA Firmette

1.3.6 Existing Drainage Improvements

There are no formal drainage improvements on site in the existing condition or the pre-demolition condition. Drainage from the project surface flows in all directions to the surrounding streets and beach.

1.3.7 Proposed Improvements

In the proposed condition, drainage will be collected in a series of catch basins and roof drains. Drainage will be routed to the parking garage where the flows will enter a storage tank capable of handling the 85th percentile rainfall. The flows from the storage tank will gravity flow through a modular wetland system (Proprietary Biofiltration Unit, BF-3), before flowing to a wet well. Flows are then pumped from the wet well to a curb pipe at the northwest corner of the site on Ebony Avenue. From this discharge point treated storm water comingles with street drainage before flowing westerly within the gutter and discharging to the beach via gutter. The pump system is being designed by a separate contractor. Drainage from the public sidewalks and surrounding public hardscape will continue to flow into the adjacent streets and flow untreated into the gutter before being discharged to the Pacific Ocean, as in the existing condition.

Section 2 Study Objectives

The specific objectives of this study are as follows:

- To provide hydrologic analysis of the project site for the 100-year, 6-hour storm event under existing and proposed conditions,
- To ensure that no additional runoff or downstream impacts occur due to this project.

Section 3 Methodology

3.1. Hydrology

Because the size of the site, the Rational Method was chosen for the analysis. The rational method is used for situations where the basin is less than 1 square mile, and the flow path for the drainage does not exceed 500 feet. Therefore the hydrologic analysis has been completed using the Rational Method (Q = CIA) (see County of San Diego Hydrology Manual, Section 3). Whereas,

Q = rate of flow in cubic feet per second

C = Coefficient of runoff,

I = intensity of rainfall based on the time of concentration and the 6-hour, 100-year precipitation

A=Area of the basin.

Runoff coeffecients were obtained using Table 3-1 of the County of San Diego Hydrology Manual. A value of 0.85 was chosen, which represents Office Proffesional/Commercial. Because the usage in both the existing condition and the proposed condition are similar, a similar coefficient was used for both conditions. Data was entered into an Excel Spreadsheet which calculates the runoff based on the County of San Diego methodology electronically (County of San Diego Figure 3-1), therefore reducing errors.

For the both the existing and proposed condition the intensity was calculated using the 6 hour and 24 hour 100 year rainfall events for the site area.

The following software packages were used in the analysis of the project:

- Microsoft Excel (Rational Method Hydrology)
- AES Software

Proposed improvements will increase the total peak flow runoff (as compared to existing conditions) in the unmitigated condition. However, through the use of a treatment storage tank and treatment system the project will reduce the peak flow from the site in the mitigated condition.

3.2. 100-Year Flow Control

Hydrographs of the 100-year storm were generated using the RatHydro program. The RatHydro program uses the method outlined in the County of San Diego Hydrology Manual to generate hydrographs consistent with the County of San Diego. These hydrographs were then entered into the Hydraflow Hydrographs as well as the data for the storage tank and outlet. The simulation showed that the 100-year flows were mitigated to below pre-project levels. A copy of the calculations has been included in the appendix of the report.

Section 4 Results

4.1. Hydrologic Results

The following tables summarize the hydrologic analysis of the project. A hydraulic summary of pipe sizing will be completed in conjunction with design of the pump system.

- **Table 1** - summarizes the existing hydrologic properties of the project site.
- **Table 2** - summarizes the proposed condition hydrology of the site in the unmitigated condition.
- **Table 3** - summarizes the proposed condition hydrology of the site in the mitigated condition.
- **Table 4** - compares the existing and proposed mitigated conditions

Table 1–Existing Condition

Sub Basin No.	Runoff Coefficient	Basin Intensity (in/hr)	Basin Area (acres)	Runoff (cfs)
Basin A	0.82	5.27	0.47	1.98
Basin B	0.82	5.27	0.53	2.23
TOTALS			**1.00**	**4.21**

Table 2–Proposed Condition (Unmitigated)

Sub Basin No.	Runoff Coefficient	Basin Intensity (in/hr)	Basin Area (acres)	Runoff (cfs)
Basin A	0.82	5.27	1.00	4.22
TOTALS			**1.00**	**4.22**

Table 3–Proposed Condition (Mitigated)

Sub Basin No.	Runoff Coefficient	Basin Intensity (in/hr)	Basin Area (acres)	Runoff (cfs)
Basin A	0.82	5.27	1.00	0.22
TOTALS			**1.00**	**0.22**

Table 4–Comparison of Flows (Mitigated)

Sub Basin No.	Existing Condition (cfs)	Proposed Condition (cfs)	Difference
Basin A	4.21	0.22	-3.99
TOTALS	**4.21**	**0.22**	**-3.99**

Section 5 Conclusions

As indicated in Table of Hydrologic Results, the proposed improvements will not increase the total 100-year, 6-hour peak flow rate. In the mitigated condition the flow rate will be 0.223 cfs, a rate less than in the existing condition.

There is not a significant concern for erosion as the site is previously developed. Potential for erosion for the proposed condition shall be minimized by following items listed in the Erosion Control Plan (part of the Rough Grading Plans). Runoff shall flow over relatively flat areas where scour is not a concern. Runoff is not proposed over any sloped areas.

Section 6 References

Imperial Beach Municipal Code

County of San Diego, 2003. Hydrology Manual (2003),

County of San Diego, 2014 Hydraulic Design Manual (2014).

FEMA, 1997. FEMA. (June 17, 1997). Flood Insurance Study, San Diego County.

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Appendix A
Rainfall Isopluvials

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

SITE

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

SITE

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
POWAY
S.D. COUNTY
DEL MAR
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

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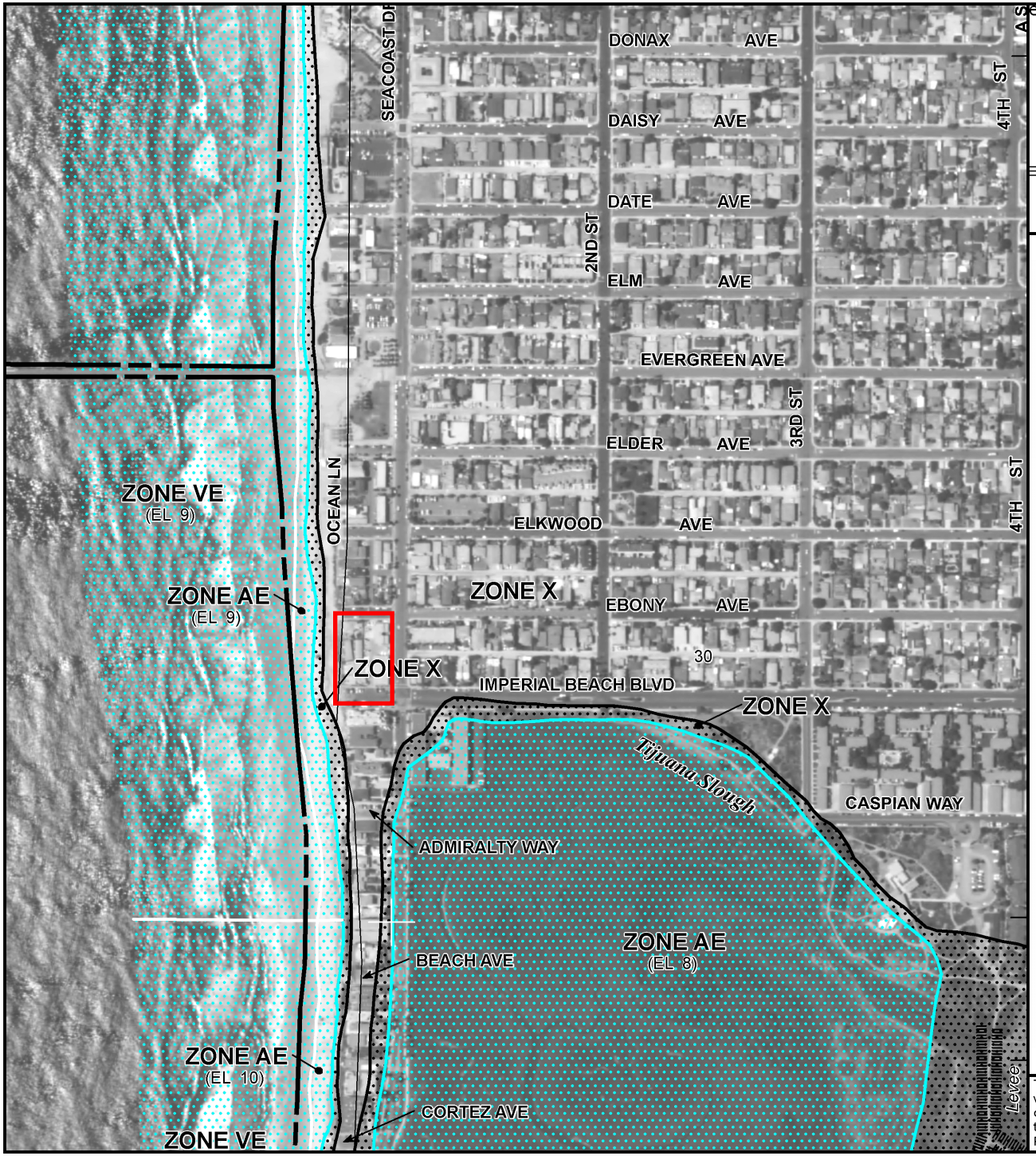
Appendix B
FEMA Flood Plain Maps



e Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2134G

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 2134 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
IMPERIAL BEACH, CITY OF	060291	2134	G

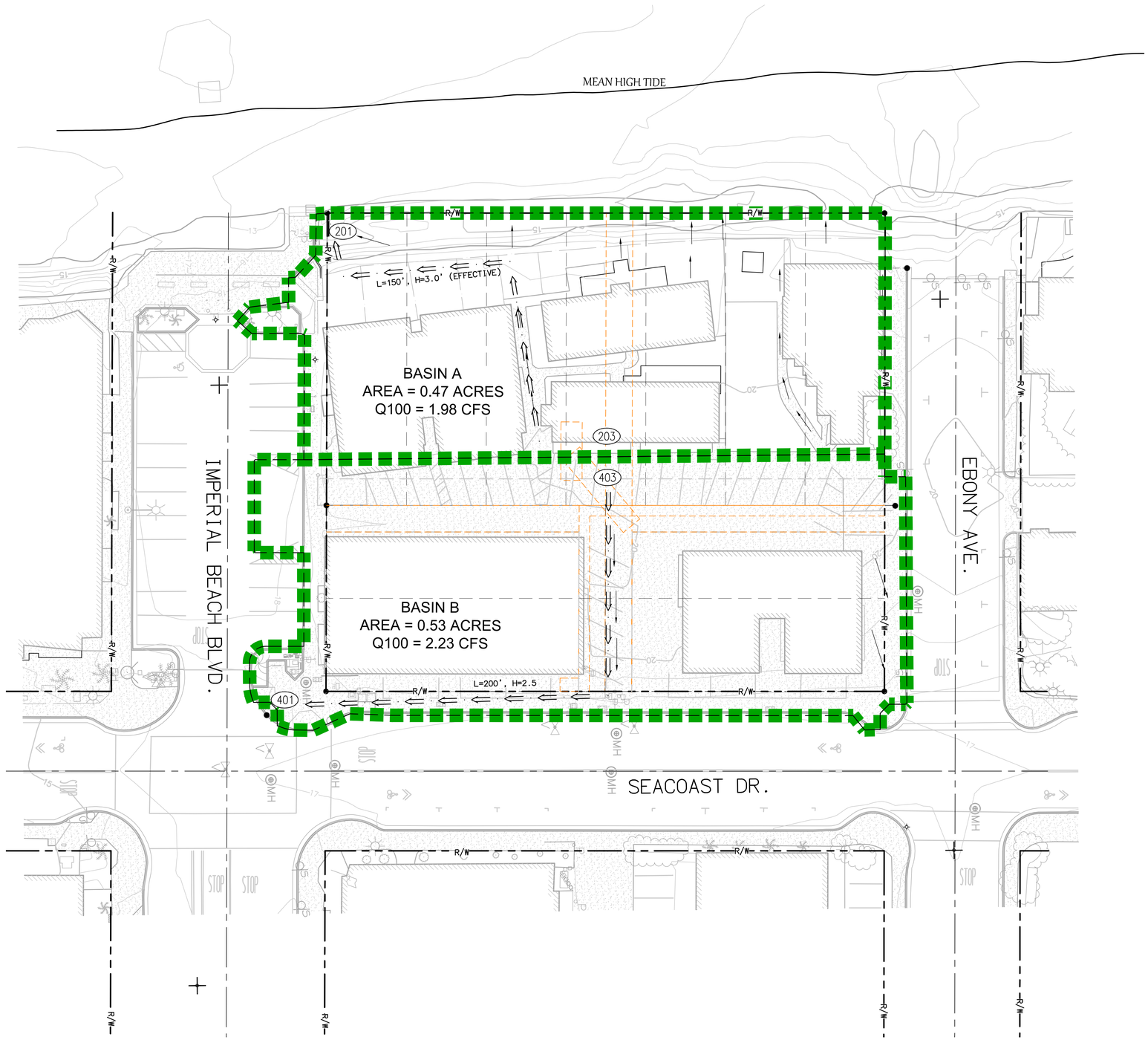
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06073C2134G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

Appendix C
Existing Condition Hydrologic Work Map & Calculations



LEGEND

- LIMITS OF OVERALL
- NODE (XXX)
- DRAINAGE BASIN FLOW DIRECTION
- EXISTING CONTOUR (400)
- EXISTING FIRE HYDRANT
- EXISTING STREET LIGHT
- EXISTING CURB
- FENCE LINE
- GATE
- SEWER MANHOLE
- SEWER CLEAN OUT
- STORM DRAIN MANHOLE
- DRAIN INLET/CATCH BASIN
- FIRE HYDRANT
- ELECTRIC METER
- ELECTRIC PULL BOX (PB)
- POWER POLE (PP)
- AREA LIGHT
- STREET LIGHT
- BACK FLOW PREVENTER (BFP)
- TELEPHONE VAULT (TELVLT)
- ELECTRIC TRANSFORMER (TRANS)
- WATER VAULT (WVLT)

SCALE: 1"=20

20 0 20 40 60

SCALE: 1"=20'

IMPERIAL BEACH RESORT

1046 SEACOAST DR.
IMPERIAL BEACH, CA

EXISTING CONDITIONS DRAINAGE AREAS

02/16/17

Michael Baker INTERNATIONAL
9755 Clairemont Mesa Boulevard
San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                              Analysis prepared by:

                            Michael Baker International
                             9755 Clairemont Mesa Blvd.
                                San Diego, CA 92124


 ************************* DESCRIPTION OF STUDY *************************
* Imperial Beach Resort                                                 *
* 100-year Flows                                                        *
* February 16, 2017                                                     *
 ************************************************************************

  FILE NAME: C:\IB\EX.DAT
  TIME/DATE OF STUDY: 14:40 02/16/2017
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.000
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    201.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8000
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  92
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   150.00
  UPSTREAM ELEVATION(FEET) =     21.00
  DOWNSTREAM ELEVATION(FEET) =     18.00
```

```
  ELEVATION DIFFERENCE(FEET) =      3.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.712
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    75.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.269
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      1.98
  TOTAL AREA(ACRES) =      0.47   TOTAL RUNOFF(CFS) =      1.98

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8000
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  92
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  UPSTREAM ELEVATION(FEET) =     20.00
  DOWNSTREAM ELEVATION(FEET) =     17.50
  ELEVATION DIFFERENCE(FEET) =      2.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.003
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    63.75
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.269
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      2.23
  TOTAL AREA(ACRES) =      0.53   TOTAL RUNOFF(CFS) =      2.23
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.5  TC(MIN.) =      4.00
  PEAK FLOW RATE(CFS)   =       2.23
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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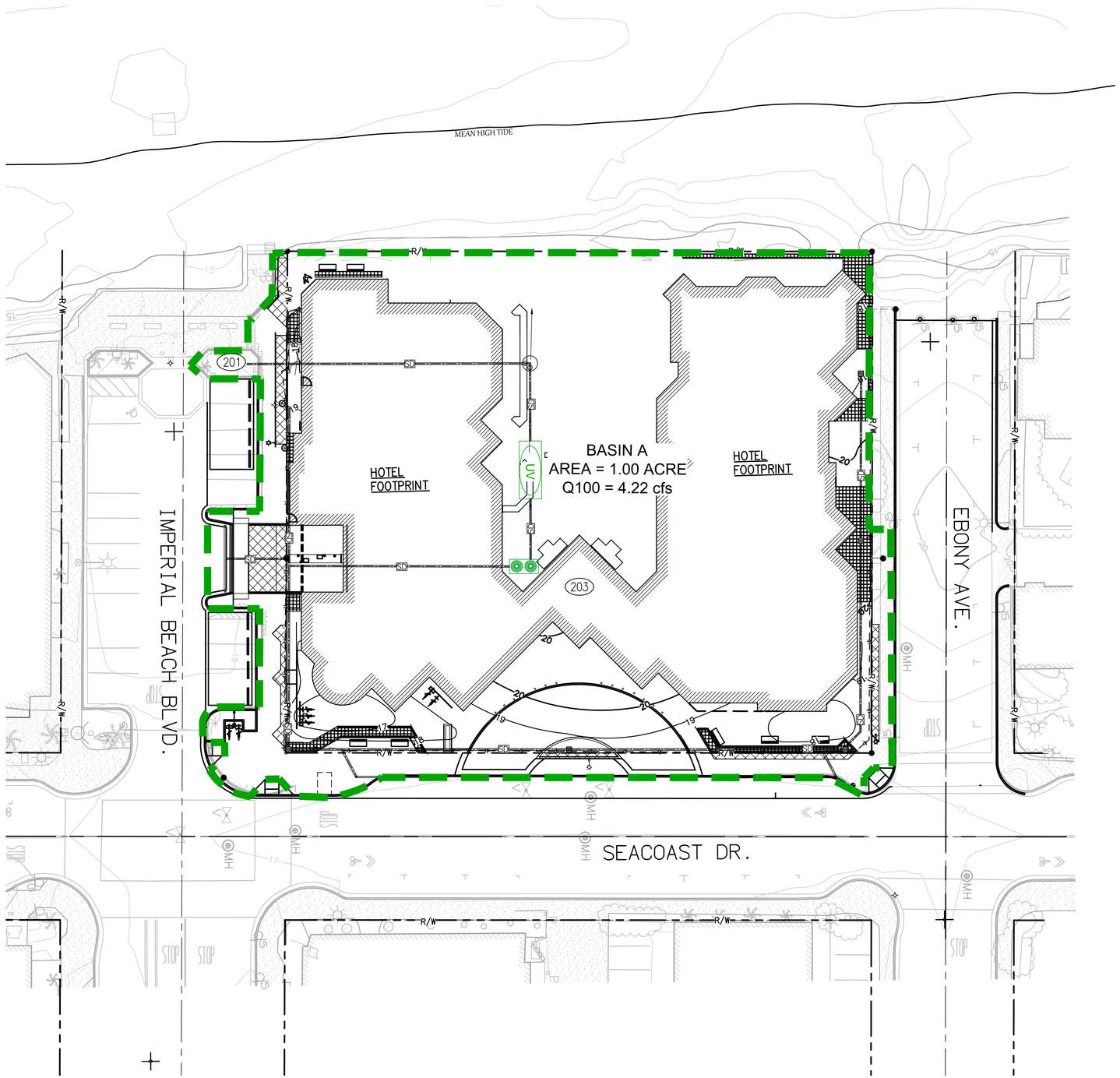
INTERNATIONAL

Appendix D
Proposed Condition Hydrologic Work Map & Calculations



LEGEND

LIMITS OF OVERALL	
NODE	XXX
DRAINAGE BASIN FLOW DIRECTION	
EXISTING CONTOUR	400
EXISTING FIRE HYDRANT	
EXISTING STREET LIGHT	
EXISTING CURB	
FENCE LINE	
GATE	
SEWER MANHOLE	S
SEWER CLEAN OUT	
STORM DRAIN MANHOLE	
DRAIN INLET/CATCH BASIN	
FIRE HYDRANT	
ELECTRIC METER	
ELECTRIC PULL BOX	PB
POWER POLE	PP
AREA LIGHT	
STREET LIGHT	
BACK FLOW PREVENTER	BFP
TELEPHONE VAULT	TELVLT
ELECTRIC TRANSFORMER	TRANS
WATER VAULT	WVLT

IMPERIAL BEACH RESORT

1046 SEACOAST DR.
IMPERIAL BEACH, CA

PROPOSED CONDITIONS DRAINAGE AREAS

02/16/17

SCALE: 1"=20

20 0 20 40 60
SCALE: 1"=20'

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Boulevard
San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                              Analysis prepared by:

                            Michael Baker International
                             9755 Clairemont Mesa Blvd.
                                San Diego, CA 92124


 ************************* DESCRIPTION OF STUDY *************************
* Imperial Beach Resort                                                 *
* 100-Year Flows                                                        *
* February 16, 2017                                                     *
 ************************************************************************

  FILE NAME: C:\IB\PR.DAT
  TIME/DATE OF STUDY: 14:41 02/16/2017
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.000
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    201.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8000
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  92
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  UPSTREAM ELEVATION(FEET) =     21.00
  DOWNSTREAM ELEVATION(FEET) =     19.00
```

```
  ELEVATION DIFFERENCE(FEET) =      2.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.183
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.269
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      4.22
  TOTAL AREA(ACRES) =      1.00   TOTAL RUNOFF(CFS) =      4.22
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.0  TC(MIN.) =      4.18
  PEAK FLOW RATE(CFS)   =       4.22
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

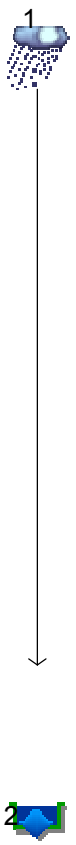
RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 2/16/2017
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2 INCHES
BASIN AREA 1 ACRES
RUNOFF COEFFICIENT 0.82
PEAK DISCHARGE 4.22 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 5	DISCHARGE (CFS) = 0.1
TIME (MIN) = 10	DISCHARGE (CFS) = 0.1
TIME (MIN) = 15	DISCHARGE (CFS) = 0.1
TIME (MIN) = 20	DISCHARGE (CFS) = 0.1
TIME (MIN) = 25	DISCHARGE (CFS) = 0.1
TIME (MIN) = 30	DISCHARGE (CFS) = 0.1
TIME (MIN) = 35	DISCHARGE (CFS) = 0.1
TIME (MIN) = 40	DISCHARGE (CFS) = 0.1
TIME (MIN) = 45	DISCHARGE (CFS) = 0.1
TIME (MIN) = 50	DISCHARGE (CFS) = 0.1
TIME (MIN) = 55	DISCHARGE (CFS) = 0.1
TIME (MIN) = 60	DISCHARGE (CFS) = 0.1
TIME (MIN) = 65	DISCHARGE (CFS) = 0.1
TIME (MIN) = 70	DISCHARGE (CFS) = 0.1
TIME (MIN) = 75	DISCHARGE (CFS) = 0.1
TIME (MIN) = 80	DISCHARGE (CFS) = 0.1
TIME (MIN) = 85	DISCHARGE (CFS) = 0.1
TIME (MIN) = 90	DISCHARGE (CFS) = 0.1
TIME (MIN) = 95	DISCHARGE (CFS) = 0.1
TIME (MIN) = 100	DISCHARGE (CFS) = 0.1
TIME (MIN) = 105	DISCHARGE (CFS) = 0.1
TIME (MIN) = 110	DISCHARGE (CFS) = 0.1
TIME (MIN) = 115	DISCHARGE (CFS) = 0.1
TIME (MIN) = 120	DISCHARGE (CFS) = 0.1
TIME (MIN) = 125	DISCHARGE (CFS) = 0.2
TIME (MIN) = 130	DISCHARGE (CFS) = 0.2
TIME (MIN) = 135	DISCHARGE (CFS) = 0.2
TIME (MIN) = 140	DISCHARGE (CFS) = 0.2
TIME (MIN) = 145	DISCHARGE (CFS) = 0.2
TIME (MIN) = 150	DISCHARGE (CFS) = 0.2
TIME (MIN) = 155	DISCHARGE (CFS) = 0.2
TIME (MIN) = 160	DISCHARGE (CFS) = 0.2
TIME (MIN) = 165	DISCHARGE (CFS) = 0.2
TIME (MIN) = 170	DISCHARGE (CFS) = 0.2
TIME (MIN) = 175	DISCHARGE (CFS) = 0.2
TIME (MIN) = 180	DISCHARGE (CFS) = 0.2
TIME (MIN) = 185	DISCHARGE (CFS) = 0.2
TIME (MIN) = 190	DISCHARGE (CFS) = 0.3
TIME (MIN) = 195	DISCHARGE (CFS) = 0.3
TIME (MIN) = 200	DISCHARGE (CFS) = 0.3
TIME (MIN) = 205	DISCHARGE (CFS) = 0.3
TIME (MIN) = 210	DISCHARGE (CFS) = 0.3
TIME (MIN) = 215	DISCHARGE (CFS) = 0.4
TIME (MIN) = 220	DISCHARGE (CFS) = 0.4
TIME (MIN) = 225	DISCHARGE (CFS) = 0.5
TIME (MIN) = 230	DISCHARGE (CFS) = 0.6
TIME (MIN) = 235	DISCHARGE (CFS) = 0.9
TIME (MIN) = 240	DISCHARGE (CFS) = 1.3
TIME (MIN) = 245	DISCHARGE (CFS) = 4.22
TIME (MIN) = 250	DISCHARGE (CFS) = 0.7
TIME (MIN) = 255	DISCHARGE (CFS) = 0.5
TIME (MIN) = 260	DISCHARGE (CFS) = 0.4
TIME (MIN) = 265	DISCHARGE (CFS) = 0.3
TIME (MIN) = 270	DISCHARGE (CFS) = 0.3
TIME (MIN) = 275	DISCHARGE (CFS) = 0.2
TIME (MIN) = 280	DISCHARGE (CFS) = 0.2
TIME (MIN) = 285	DISCHARGE (CFS) = 0.2
TIME (MIN) = 290	DISCHARGE (CFS) = 0.2
TIME (MIN) = 295	DISCHARGE (CFS) = 0.2
TIME (MIN) = 300	DISCHARGE (CFS) = 0.2
TIME (MIN) = 305	DISCHARGE (CFS) = 0.2
TIME (MIN) = 310	DISCHARGE (CFS) = 0.1
TIME (MIN) = 315	DISCHARGE (CFS) = 0.1
TIME (MIN) = 320	DISCHARGE (CFS) = 0.1
TIME (MIN) = 325	DISCHARGE (CFS) = 0.1
TIME (MIN) = 330	DISCHARGE (CFS) = 0.1
TIME (MIN) = 335	DISCHARGE (CFS) = 0.1
TIME (MIN) = 340	DISCHARGE (CFS) = 0.1
TIME (MIN) = 345	DISCHARGE (CFS) = 0.1
TIME (MIN) = 350	DISCHARGE (CFS) = 0.1
TIME (MIN) = 355	DISCHARGE (CFS) = 0.1
TIME (MIN) = 360	DISCHARGE (CFS) = 0.1
TIME (MIN) = 365	DISCHARGE (CFS) = 0

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Legend

Hyd.	Origin	Description
1	Manual	Input Hydrograph
2	Reservoir	Outflow Hydrograph

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Manual	------	-------	-------	-------	-------	-------	-------	-------	4.220	Input Hydrograph
2	Reservoir	1	-------	-------	-------	-------	-------	-------	-------	0.223	Outflow Hydrograph

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

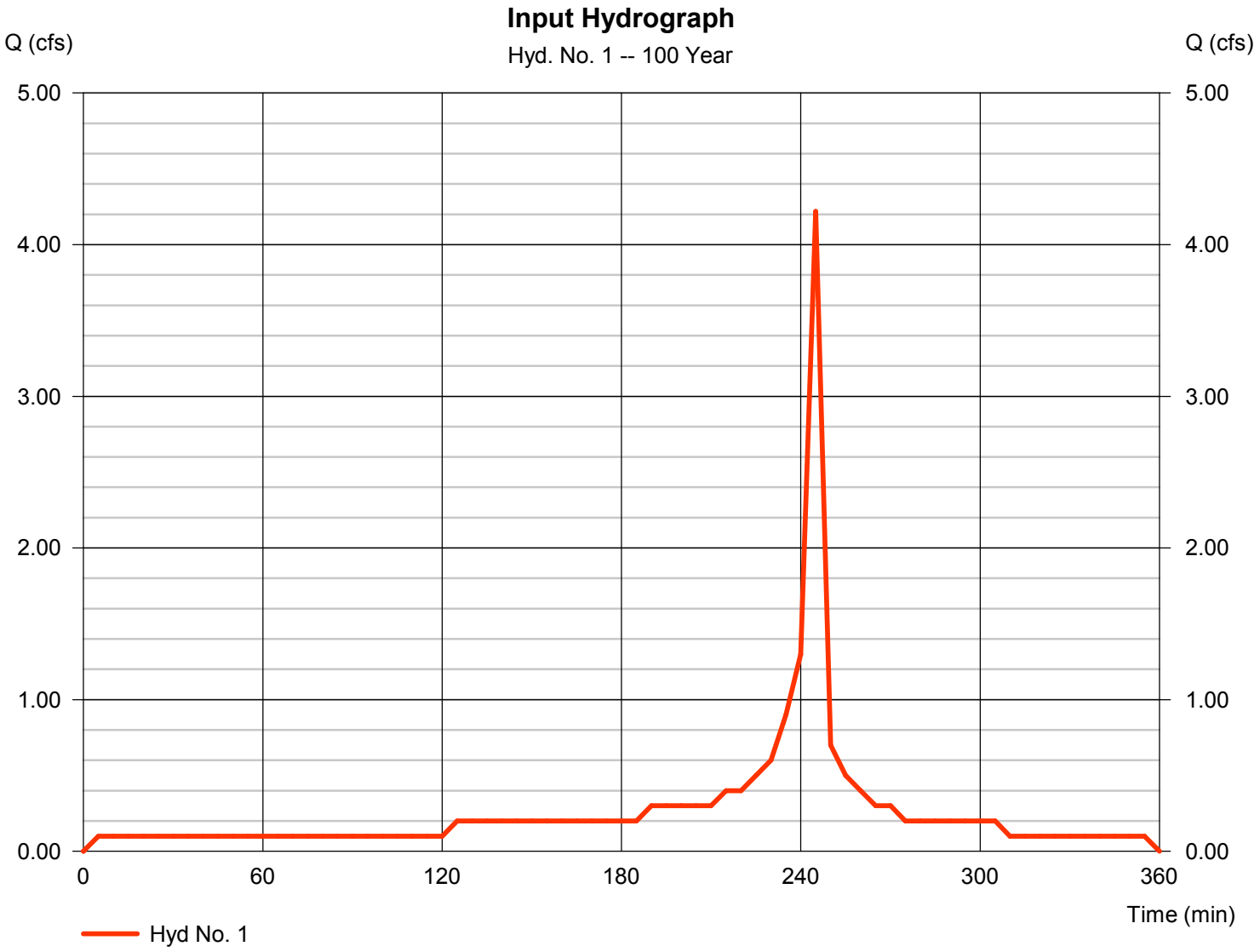
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	4.220	5	245	5,826	------	------	------	Input Hydrograph
2	Reservoir	0.223	5	195	5,825	1	103.89	2,614	Outflow Hydrograph

Hydrograph Report

Hyd. No. 1

Input Hydrograph

Hydrograph type	= Manual	Peak discharge	= 4.220 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 5,826 cuft



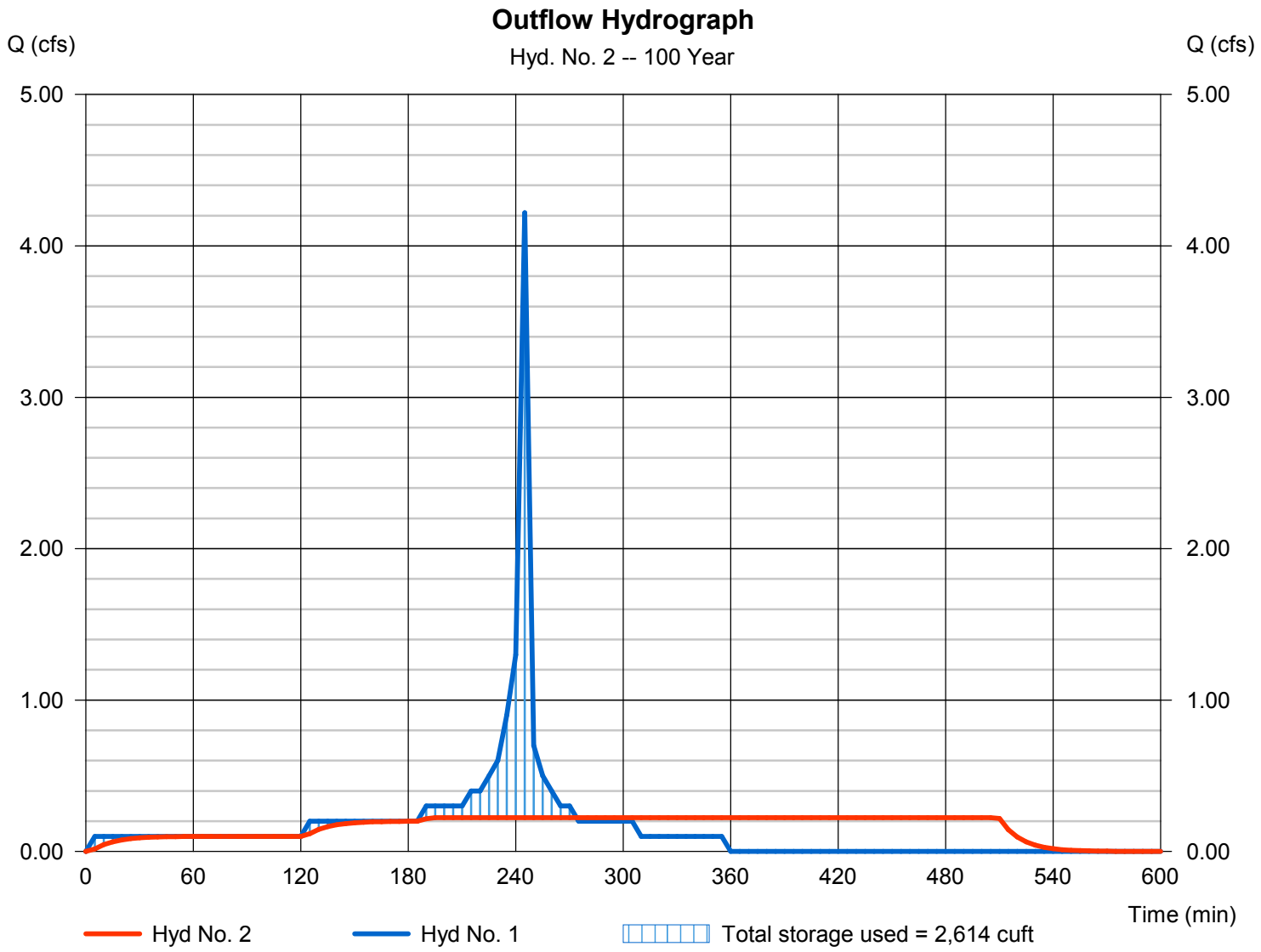
Hydrograph Report

Hyd. No. 2

Outflow Hydrograph

Hydrograph type	=	Reservoir	Peak discharge	=	0.223 cfs
Storm frequency	=	100 yrs	Time to peak	=	195 min
Time interval	=	5 min	Hyd. volume	=	5,825 cuft
Inflow hyd. No.	=	1 - Input Hydrograph	Max. Elevation	=	103.89 ft
Reservoir name	=	Storage Tank	Max. Storage	=	2,614 cuft

Storage Indication method used.



Hydrograph Report

Hyd. No. 1

Input Hydrograph

Hydrograph type	= Manual	Peak discharge	= 4.220 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.08 hrs
Time interval	= 5 min	Hyd. volume	= 5,826 cuft

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
0.08	0.100	1.83	0.100	3.58	0.400	5.33	0.100
0.17	0.100	1.92	0.100	3.67	0.400	5.42	0.100
0.25	0.100	2.00	0.100	3.75	0.500	5.50	0.100
0.33	0.100	2.08	0.200	3.83	0.600	5.58	0.100
0.42	0.100	2.17	0.200	3.92	0.900	5.67	0.100
0.50	0.100	2.25	0.200	4.00	1.300	5.75	0.100
0.58	0.100	2.33	0.200	4.08	4.220	5.83	0.100
0.67	0.100	2.42	0.200	4.17	0.700	5.92	0.100
0.75	0.100	2.50	0.200	4.25	0.500	*...End*	
0.83	0.100	2.58	0.200	4.33	0.400		
0.92	0.100	2.67	0.200	4.42	0.300		
1.00	0.100	2.75	0.200	4.50	0.300		
1.08	0.100	2.83	0.200	4.58	0.200		
1.17	0.100	2.92	0.200	4.67	0.200		
1.25	0.100	3.00	0.200	4.75	0.200		
1.33	0.100	3.08	0.200	4.83	0.200		
1.42	0.100	3.17	0.300	4.92	0.200		
1.50	0.100	3.25	0.300	5.00	0.200		
1.58	0.100	3.33	0.300	5.08	0.200		
1.67	0.100	3.42	0.300	5.17	0.100		
1.75	0.100	3.50	0.300	5.25	0.100		

<<

Hydrograph Report

Hyd. No. 2

Outflow Hydrograph

Hydrograph type	= Reservoir	Peak discharge	= 0.223 cfs
Storm frequency	= 100 yrs	Time to peak	= 3.25 hrs
Time interval	= 5 min	Hyd. volume	= 5,825 cuft
Inflow hyd. No.	= 1 - Input Hydrograph	Reservoir name	= Storage Tank
Max. Elevation	= 103.89 ft	Max. Storage	= 2,614 cuft

Storage Indication method used.

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.08	0.100	100.04	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.017
0.17	0.100	100.10	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.045
0.25	0.100	100.14	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.064
0.33	0.100	100.17	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.076
0.42	0.100	100.19	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.084
0.50	0.100	100.20	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.090
0.58	0.100	100.21	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.093
0.67	0.100	100.21	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.095
0.75	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.097
0.83	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.098
0.92	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.099
1.00	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.099
1.08	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.099
1.17	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.25	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.33	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.42	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.50	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.58	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.67	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100

Continues on next page...

Outflow Hydrograph

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
1.75	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.83	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
1.92	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
2.00	0.100	100.22	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.100
2.08	0.200	100.26	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.117
2.17	0.200	100.33	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.145
2.25	0.200	100.37	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.164
2.33	0.200	100.39	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.176
2.42	0.200	100.41	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.184
2.50	0.200	100.43	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.190
2.58	0.200	100.43	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.193
2.67	0.200	100.44	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.195
2.75	0.200	100.44	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.197
2.83	0.200	100.44	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.198
2.92	0.200	100.45	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.199
3.00	0.200	100.45	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.199
3.08	0.200	100.45	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.199
3.17	0.300	100.49	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.217
3.25	0.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.33	0.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.42	0.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.50	0.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.58	0.400	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.67	0.400	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.75	0.500	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<

Outflow Hydrograph

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
3.83	0.600	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
3.92	0.900	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.00	1.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.08	4.220 <<	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.17	0.700	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.25	0.500	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.33	0.400	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.42	0.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.50	0.300	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.58	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.67	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.75	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.83	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
4.92	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.00	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.08	0.200	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.17	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.25	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.33	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<

Outflow Hydrograph

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
5.42	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.50	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.58	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.67	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.75	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.83	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
5.92	0.100	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.00	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.08	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.17	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.25	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.33	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.42	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.50	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.58	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.67	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.75	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.83	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
6.92	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<

Outflow Hydrograph

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
7.00	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.08	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.17	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.25	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.33	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.42	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.50	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.58	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.67	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.75	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.83	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
7.92	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.00	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.08	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.17	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.25	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.33	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.42	0.000	100.50 <<	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.223 <<
8.50	0.000	100.49	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.218

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Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
8.58	0.000	100.32	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.144
8.67	0.000	100.21	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.095
8.75	0.000	100.14	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.063
8.83	0.000	100.09	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.041
8.92	0.000	100.06	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.027
9.00	0.000	100.04	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.018
9.08	0.000	100.03	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.012
9.17	0.000	100.02	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.008
9.25	0.000	100.01	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.005
9.33	0.000	100.01	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.003
9.42	0.000	100.01	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.002

...End

Pond No. 1 - Storage Tank

Pond Data

UG Chambers -Invert elev. = 100.00 ft, Rise x Span = 5.00 x 5.00 ft, Barrel Len = 160.00 ft, No. Barrels = 1, Slope = 0.00%, Headers = No

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	n/a	0	0
0.50	100.50	n/a	164	164
1.00	101.00	n/a	284	448
1.50	101.50	n/a	346	793
2.00	102.00	n/a	381	1,174
2.50	102.50	n/a	398	1,571
3.00	103.00	n/a	398	1,969
3.50	103.50	n/a	381	2,350
4.00	104.00	n/a	345	2,695
4.50	104.50	n/a	284	2,979
5.00	105.00	n/a	163	3,142

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	100.00	---	---	---	---	---	---	---	---	---	---	0.000
0.05	16	100.05	---	---	---	---	---	---	---	---	---	0.022	0.022
0.10	33	100.10	---	---	---	---	---	---	---	---	---	0.045	0.045
0.15	49	100.15	---	---	---	---	---	---	---	---	---	0.067	0.067
0.20	65	100.20	---	---	---	---	---	---	---	---	---	0.089	0.089
0.25	82	100.25	---	---	---	---	---	---	---	---	---	0.112	0.112
0.30	98	100.30	---	---	---	---	---	---	---	---	---	0.134	0.134
0.35	114	100.35	---	---	---	---	---	---	---	---	---	0.156	0.156
0.40	131	100.40	---	---	---	---	---	---	---	---	---	0.178	0.178
0.45	147	100.45	---	---	---	---	---	---	---	---	---	0.201	0.201
0.50	164	100.50	---	---	---	---	---	---	---	---	---	0.223	0.223
0.55	192	100.55	---	---	---	---	---	---	---	---	---	0.223	0.223
0.60	220	100.60	---	---	---	---	---	---	---	---	---	0.223	0.223
0.65	249	100.65	---	---	---	---	---	---	---	---	---	0.223	0.223
0.70	277	100.70	---	---	---	---	---	---	---	---	---	0.223	0.223
0.75	306	100.75	---	---	---	---	---	---	---	---	---	0.223	0.223
0.80	334	100.80	---	---	---	---	---	---	---	---	---	0.223	0.223
0.85	362	100.85	---	---	---	---	---	---	---	---	---	0.223	0.223
0.90	391	100.90	---	---	---	---	---	---	---	---	---	0.223	0.223
0.95	419	100.95	---	---	---	---	---	---	---	---	---	0.223	0.223
1.00	448	101.00	---	---	---	---	---	---	---	---	---	0.223	0.223
1.05	482	101.05	---	---	---	---	---	---	---	---	---	0.223	0.223
1.10	517	101.10	---	---	---	---	---	---	---	---	---	0.223	0.223
1.15	551	101.15	---	---	---	---	---	---	---	---	---	0.223	0.223
1.20	586	101.20	---	---	---	---	---	---	---	---	---	0.223	0.223
1.25	620	101.25	---	---	---	---	---	---	---	---	---	0.223	0.223
1.30	655	101.30	---	---	---	---	---	---	---	---	---	0.223	0.223
1.35	690	101.35	---	---	---	---	---	---	---	---	---	0.223	0.223
1.40	724	101.40	---	---	---	---	---	---	---	---	---	0.223	0.223
1.45	759	101.45	---	---	---	---	---	---	---	---	---	0.223	0.223
1.50	793	101.50	---	---	---	---	---	---	---	---	---	0.223	0.223
1.55	831	101.55	---	---	---	---	---	---	---	---	---	0.223	0.223

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Storage Tank

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.60	869	101.60	---	---	---	---	---	---	---	---	---	0.223	0.223
1.65	907	101.65	---	---	---	---	---	---	---	---	---	0.223	0.223
1.70	945	101.70	---	---	---	---	---	---	---	---	---	0.223	0.223
1.75	984	101.75	---	---	---	---	---	---	---	---	---	0.223	0.223
1.80	1,022	101.80	---	---	---	---	---	---	---	---	---	0.223	0.223
1.85	1,060	101.85	---	---	---	---	---	---	---	---	---	0.223	0.223
1.90	1,098	101.90	---	---	---	---	---	---	---	---	---	0.223	0.223
1.95	1,136	101.95	---	---	---	---	---	---	---	---	---	0.223	0.223
2.00	1,174	102.00	---	---	---	---	---	---	---	---	---	0.223	0.223
2.05	1,214	102.05	---	---	---	---	---	---	---	---	---	0.223	0.223
2.10	1,253	102.10	---	---	---	---	---	---	---	---	---	0.223	0.223
2.15	1,293	102.15	---	---	---	---	---	---	---	---	---	0.223	0.223
2.20	1,333	102.20	---	---	---	---	---	---	---	---	---	0.223	0.223
2.25	1,373	102.25	---	---	---	---	---	---	---	---	---	0.223	0.223
2.30	1,412	102.30	---	---	---	---	---	---	---	---	---	0.223	0.223
2.35	1,452	102.35	---	---	---	---	---	---	---	---	---	0.223	0.223
2.40	1,492	102.40	---	---	---	---	---	---	---	---	---	0.223	0.223
2.45	1,532	102.45	---	---	---	---	---	---	---	---	---	0.223	0.223
2.50	1,571	102.50	---	---	---	---	---	---	---	---	---	0.223	0.223
2.55	1,611	102.55	---	---	---	---	---	---	---	---	---	0.223	0.223
2.60	1,651	102.60	---	---	---	---	---	---	---	---	---	0.223	0.223
2.65	1,691	102.65	---	---	---	---	---	---	---	---	---	0.223	0.223
2.70	1,731	102.70	---	---	---	---	---	---	---	---	---	0.223	0.223
2.75	1,770	102.75	---	---	---	---	---	---	---	---	---	0.223	0.223
2.80	1,810	102.80	---	---	---	---	---	---	---	---	---	0.223	0.223
2.85	1,850	102.85	---	---	---	---	---	---	---	---	---	0.223	0.223
2.90	1,890	102.90	---	---	---	---	---	---	---	---	---	0.223	0.223
2.95	1,929	102.95	---	---	---	---	---	---	---	---	---	0.223	0.223
3.00	1,969	103.00	---	---	---	---	---	---	---	---	---	0.223	0.223
3.05	2,007	103.05	---	---	---	---	---	---	---	---	---	0.223	0.223
3.10	2,045	103.10	---	---	---	---	---	---	---	---	---	0.223	0.223
3.15	2,083	103.15	---	---	---	---	---	---	---	---	---	0.223	0.223
3.20	2,121	103.20	---	---	---	---	---	---	---	---	---	0.223	0.223
3.25	2,159	103.25	---	---	---	---	---	---	---	---	---	0.223	0.223
3.30	2,197	103.30	---	---	---	---	---	---	---	---	---	0.223	0.223
3.35	2,235	103.35	---	---	---	---	---	---	---	---	---	0.223	0.223
3.40	2,274	103.40	---	---	---	---	---	---	---	---	---	0.223	0.223
3.45	2,312	103.45	---	---	---	---	---	---	---	---	---	0.223	0.223
3.50	2,350	103.50	---	---	---	---	---	---	---	---	---	0.223	0.223
3.55	2,384	103.55	---	---	---	---	---	---	---	---	---	0.223	0.223
3.60	2,419	103.60	---	---	---	---	---	---	---	---	---	0.223	0.223
3.65	2,453	103.65	---	---	---	---	---	---	---	---	---	0.223	0.223
3.70	2,488	103.70	---	---	---	---	---	---	---	---	---	0.223	0.223
3.75	2,522	103.75	---	---	---	---	---	---	---	---	---	0.223	0.223
3.80	2,557	103.80	---	---	---	---	---	---	---	---	---	0.223	0.223
3.85	2,591	103.85	---	---	---	---	---	---	---	---	---	0.223	0.223
3.90	2,626	103.90	---	---	---	---	---	---	---	---	---	0.223	0.223
3.95	2,660	103.95	---	---	---	---	---	---	---	---	---	0.223	0.223
4.00	2,695	104.00	---	---	---	---	---	---	---	---	---	0.223	0.223
4.05	2,723	104.05	---	---	---	---	---	---	---	---	---	0.223	0.223
4.10	2,752	104.10	---	---	---	---	---	---	---	---	---	0.223	0.223
4.15	2,780	104.15	---	---	---	---	---	---	---	---	---	0.223	0.223
4.20	2,809	104.20	---	---	---	---	---	---	---	---	---	0.223	0.223
4.25	2,837	104.25	---	---	---	---	---	---	---	---	---	0.223	0.223
4.30	2,865	104.30	---	---	---	---	---	---	---	---	---	0.223	0.223
4.35	2,894	104.35	---	---	---	---	---	---	---	---	---	0.223	0.223
4.40	2,922	104.40	---	---	---	---	---	---	---	---	---	0.223	0.223
4.45	2,951	104.45	---	---	---	---	---	---	---	---	---	0.223	0.223
4.50	2,979	104.50	---	---	---	---	---	---	---	---	---	0.223	0.223
4.55	2,995	104.55	---	---	---	---	---	---	---	---	---	0.223	0.223
4.60	3,012	104.60	---	---	---	---	---	---	---	---	---	0.223	0.223
4.65	3,028	104.65	---	---	---	---	---	---	---	---	---	0.223	0.223
4.70	3,044	104.70	---	---	---	---	---	---	---	---	---	0.223	0.223
4.75	3,061	104.75	---	---	---	---	---	---	---	---	---	0.223	0.223
4.80	3,077	104.80	---	---	---	---	---	---	---	---	---	0.223	0.223
4.85	3,093	104.85	---	---	---	---	---	---	---	---	---	0.223	0.223
4.90	3,110	104.90	---	---	---	---	---	---	---	---	---	0.223	0.223
4.95	3,126	104.95	---	---	---	---	---	---	---	---	---	0.223	0.223
5.00	3,142	105.00	---	---	---	---	---	---	---	---	---	0.223	0.223

...End

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	23.4524	10.7000	0.8280	--------
3	0.0000	0.0000	0.0000	--------
5	41.1097	10.9000	0.8313	--------
10	49.7363	10.2000	0.8128	--------
25	69.7924	10.9000	0.8348	--------
50	280.3318	26.3001	1.0717	--------
100	728.0350	36.7000	1.2251	--------

File name: scripps-intensity.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	2.40	1.91	1.59	1.38	1.21	1.09	0.99	0.91	0.84	0.78	0.73	0.69
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.12	3.29	2.75	2.37	2.10	1.88	1.71	1.57	1.45	1.35	1.26	1.19
10	5.45	4.32	3.61	3.12	2.75	2.47	2.25	2.06	1.91	1.78	1.67	1.57
25	6.93	5.52	4.61	3.98	3.51	3.15	2.86	2.62	2.43	2.26	2.12	1.99
50	7.00	5.97	5.20	4.60	4.12	3.73	3.40	3.13	2.90	2.69	2.52	2.36
100	7.54	6.56	5.79	5.17	4.66	4.24	3.88	3.57	3.31	3.07	2.87	2.69

Tc = time in minutes. Values may exceed 60.

Precip. file name: precip.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	0.84	0.00	1.10	2.80	1.58	1.80	4.50
SCS 6-Hr	0.00	0.61	0.00	0.79	1.60	1.14	1.31	2.90
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ATTACHMENT 6
GEOTECHNICAL AND GROUNDWATER INVESTIGATION REPORT

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Diego County Area, California

December 21, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:422 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 20 40 80 120

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 9, Sep 17, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2010—Jan 4, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

San Diego County Area, California (CA638)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
MIC	Marina loamy coarse sand, 2 to 9 percent slopes	0.8	100.0%
Totals for Area of Interest		**0.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Diego County Area, California

MIC—Marina loamy coarse sand, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hbdz
Mean annual air temperature: 57 to 61 degrees F
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Marina and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Marina

Setting

Landform: Ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands derived from mixed sources

Typical profile

H1 - 0 to 10 inches: loamy coarse sand
H2 - 10 to 57 inches: loamy sand, loamy coarse sand
H2 - 10 to 57 inches: sand, coarse sand
H3 - 57 to 60 inches:
H3 - 57 to 60 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Minor Components

Carlsbad

Percent of map unit: 5 percent

Chesterton

Percent of map unit: 5 percent

Corralitos

Percent of map unit: 5 percent

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